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CANADIAN
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VOL. XII. JANUARY, 1902 No 1.

STORAGE BATTERIES AND 60-CYCLE RAILWAY ROTARIES.

BY EDWARD L. REYNOLDS.

The use of storage batteries upon electric railways and lighting stations has within the last few years reached great prominence, and it has become an accepted fact with most engineers that batteries should necessarily form part of modern designs for power systems of this character.

The most customary applications of batteries to electric railway systems in the past have been in the stations where direct current is generated, and at points far out upon the lines, say from five to ten miles from the power house. In both cases the batteries have in general been installed to regulate the excessive fluctuations in load peculiar to railway work. By thus relieving the machinery and copper of these rapid changes in load, and obtaining a constant load factor approximating 100 per cent., the cost of operation, the maintenance of machinery and the first cost of machinery and copper have been in a great many cases reduced to an astonishing degree. Batteries have also been used very extensively in connection with roads operating from high-tension alternating-current transmission with rotary conversion to 500 volts direct current, the battery in such cases being installed in the power house and in the rotary substations.

The advantage of installations of the above general character are too well known for additional comment here, but it is the desire to call attention to one particular use of batteries in conjunction with 60-cycle rotary converters that prompts the following brief description of the Hamilton Electric Light and Cataract Power Company, of Hamilton, Ont. This application of the battery idea is of quite recent origin, and deserves most earnest consideration.

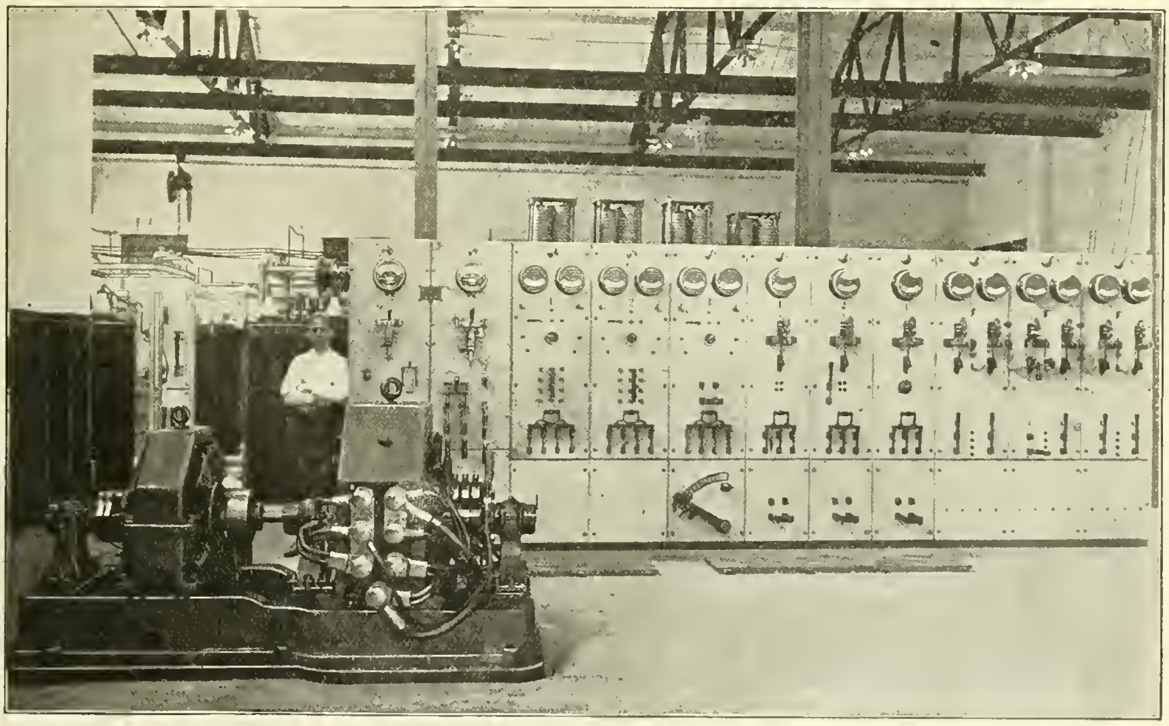


FIG. 1.—SWITCHBOARD AND BATTERY BOOSTER.

This company generates from water power. The water is taken from Lake Erie near the last lock of the Welland canal, and led about twelve miles to the edge of the mountain. Here it has a head of 275 ft., and falls to the wheels through an iron flume of 8 ft. diameter at the top and 6 ft. at the bottom. Electric power is generated at 2400 volts, two phase, and stepped up to 22,000 volts, three phase, and thus delivered thirty-four miles to Hamilton.

The sub-station at Victoria Avenue, Hamilton, contains all the machinery required to transform and distribute the current for the various uses required. Thus power is distributed to the Hamilton Street Railway Company, the Hamilton and Dundas Railway and the Hamilton Radial Railway, and is also used for light and power in the city. This light and power consists of 110-volt incandescents and arcs and alternating-current motors. The apparatus in the sub-station consists of three 300-kw, 66-cycle rotary converters, with 550-volt secondaries, ten 175-kw static transformers, 22,000-volt three phase to 2,400-volt two phase, six 150 k.w. static transformers, 22,000-volt three phase to 350-volt two phase, and a storage battery of "Chloride Accumulators" of capacity equal to 400 amps. at 550 volts.

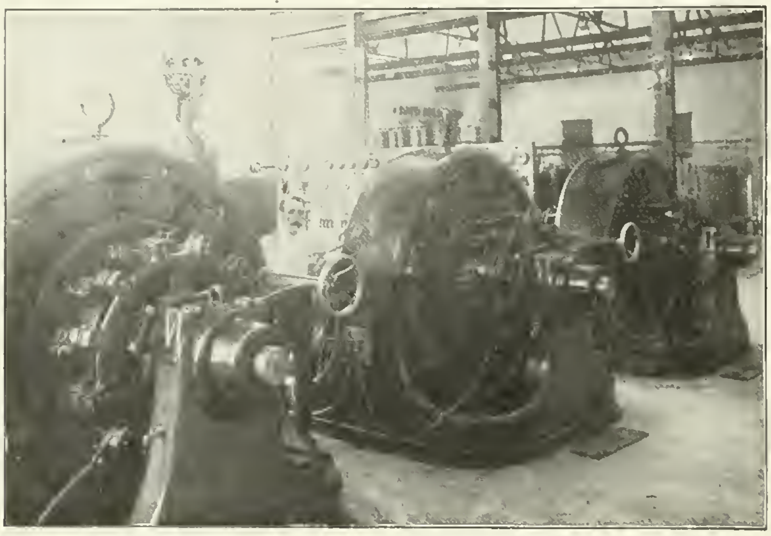


Fig. 2. Three 300 K. W. Rotaries.

The switchboard and battery booster are shown in Fig. 1, the rotaries in Fig. 2. The transformers are shown in Fig. 3. These machines supply current to the railways, and are operated in parallel with the storage battery. The latter absorbs the fluctuations of the current and enables the rotaries to run steadily with a fixed constant load, which represents the average demand of the railway circuit. It is this fact that renders it possible to operate incandescents and arcs, electric street cars and synchronous motors from the same busses fed from current over the same high-tension transmission line.

The regulating effect of this battery is shown by the two cuts, Figs. 4 and 5. Fig. 4 is a reproduction of a voltage curve taken from a recording volt-meter while the battery was in service. This voltage is taken upon the 110-volt lighting circuit, and shows a variation of such small magnitude that it is not detected from observation of the lights. Fig. 5 is a reproduction of a similar curve during a corresponding period of another day when the battery was off the circuit. Here, under the same local conditions, a fluctuation in voltage of large magnitude is seen, rendering operation impracticable.

This battery has uses other than the regulation of fluctuations. Frequently upon a system of this character some trivial accident to line or machinery will cause temporary shut-downs. In the plant under consideration such accidents have occurred several times, but the roads have never been closed down, since the battery has discharged upon such occasions to tide over the troubles. The Hamilton Company has found that one of the strongest points with regard the operation of this battery lies in the fact that it would hardly be possible to operate the rotaries without the battery on account of hunting. An additional advantage of this battery is that of supplying current to the roads during the early morning hours, when the load is light, thus giving an all-night service without the necessity of operating the rotaries continuously.

The flexibility of this system is marked, and the advantage of operating lights, synchronous motors and direct-current motors from the same transmission line is of manifest importance. It is sufficient to say that the storage battery has thus opened a field in which lighting and railway interests become one, and it is safe to predict that all high-tension transmission lines designed to supply direct current through rotaries for railways will be laid out upon the above general plan, and light furnished from the same lines wherever it is applied.—From the Street Railway Journal.

THE BREMER ARC LAMP.

Mr. Laporte read a paper before the International Society of Electricians in Paris recently, giving the results of tests of the Bremer arc lamp made in the central laboratory of electricity in Paris during the last exhibition. According to the Electrical Engineer the characteristic features of the Bremer lamp are the arrangement of the carbons, which are nearly vertical, but form an acute angle; the regulation of the arc under the influence of a magnetic field, the regulation being made automatically by the intensity of the current; and the use of a special positive carbon, the composition of which is still kept secret. For a 43 to 45 volt and 9 ampere lamp the special positive carbon has a diameter of 7 mm., while for the negative carbon a Siemens carbon of 6 mm. diameter is used. The special positive carbon has a considerably higher specific resistance—12,300 microhms centimetre—that of the Siemens carbon being between 8,300 and 9,400. The positive carbon contains a certain number of metallic salts, and during combustion rather large quantities of deposits are formed, magnesia being the

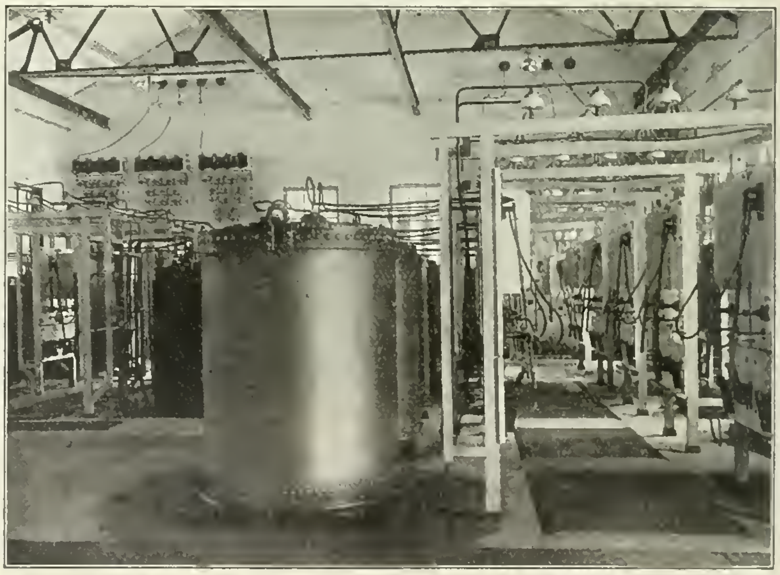


Fig. 3.—The Transformers.

principal constituent. This magnesia is deposited on a screen above the arc, which then acts as a reflector and produces a favourable distribution of the light. The colour of the light is peculiar; it is between the colour of the light of incandescent lamps and that of ordinary arc lamps without globe. The results of photometric tests and the comparison with an ordinary arc lamp show that the consumption of watts per candle for the ordinary arc lamp is about twice that for the Bremer arc lamp, the exact ratio taken from the table being $200 \div 117$. Referring to the results of his tests, the author says: "It cannot be denied that these figures are favourable to the Bremer lamp. The only point which still needs to be cleared up is whether the price of the special carbon may not offset the advantage put in evidence by the photometric tests."

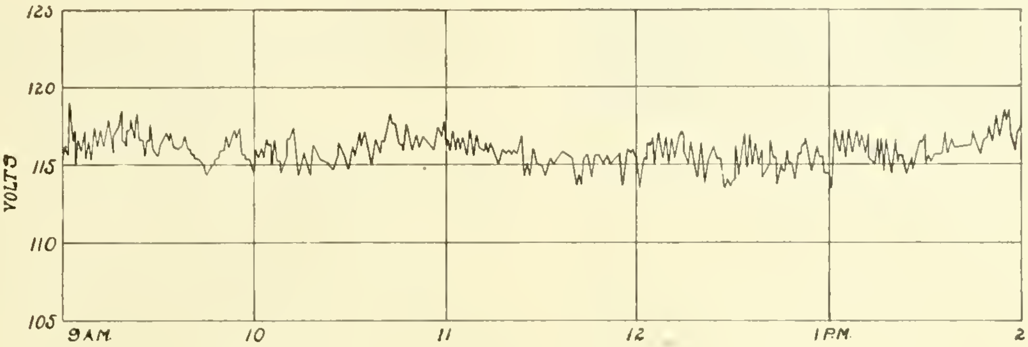


Fig. 4.—Voltage Curves, with Battery in Circuit.

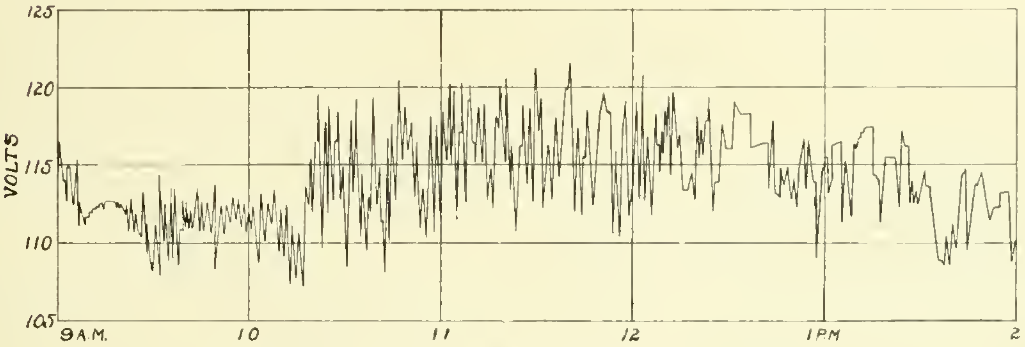
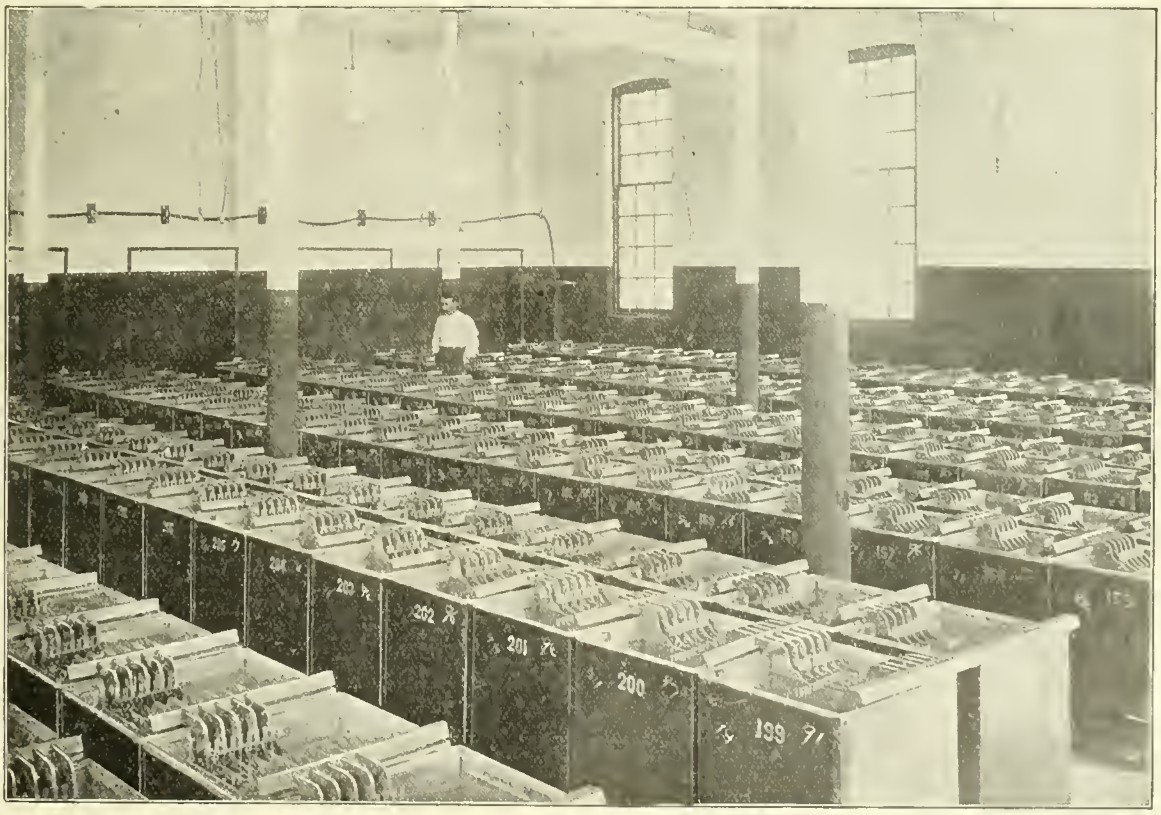


Fig. 5.—Voltage Curves, Without Battery in Circuit.



No. 6.—View in Battery Room.

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The Question Department

THE interest that is being shown in the Question and Answer Department of this journal is most gratifying to the publishers. A large number of readers have accepted the invitation to submit questions, and as a result it has been possible to give information touching a wide variety of subjects. We are thankful to those who have sent in questions, as we feel that, besides the assistance which has been given them, a live question and answer department is one of the best means of making the journal useful to and appreciated by subscribers. Questions for the February issue are now in order.

Suit Affecting Electric Lighting.

THE Ottawa Electric Company are the plaintiffs in a suit now before the Ottawa courts that is of considerable interest to electric lighting companies. The action arose out of the Ottawa-Hull fire of April, 1900, by which a large portion of the circuits and other property of the Ottawa Electric Company were destroyed. The present action is brought to recover the amount held by the corporation for alleged breach of contract. Under its agreement with the company the city is entitled to deduct 50 cents a light for the lights which are out at times in different parts of the city when they should be burning. The company, however, claim exemption in this instance, on the ground that it was through no fault or negligence on their part that the lights in question were not burning. The amount involved is between $12,000 and $15,000. Whatever may be the decision, it would seem to be a wise precaution for lighting companies to endeavor to have embodied in their agreements with municipalities a provision covering such a contingency as was responsible for the suit in question.

Electricity in Glass Making.

IT is interesting to watch the constantly broadening uses of electricity. Eventually its applications seem likely to become almost as numerous as the varied branches of industry. It is now proposed to employ a continuous electric furnace in the manufacture of glass. Since the glass is electrolytically decomposed by a continuous current, it is necessary to employ alternating currents for the electric glass furnace. The furnace contains three electric arcs, arranged along an inclined plane. Below each arc is a pocket in which the fused mass can collect and overflow to the next one. The crushed and mixed material is fed in a continuous stream, the fused glass being drawn off in like manner. The lower temperature of fusion of glass-making material as compared with those employed in the manufacture of calcium carbide, has made possible the construction of a continuous furnace. An important advantage to be secured by the use of the electric furnace in glass factories is the saving in cost and maintenance of plant, such as furnaces, regenerators, gas producers, etc. By the electric furnace the heat necessary to immediately fuse the powdered material is always available, thereby saving time. It also permits of glass-making wherever water power is available, instead of in certain localities only in which cheap fuel can be had.

Mond Gas and Gas Engines.

IN our November issue some particulars were given of the Mond fuel gas which is being exploited in England. We have since received a copy of a report on the subject made by Mr. Edward Atkinson to the Boston Manufacturers' Mutual Fire Insurance Company. Mr. Atkinson has recently returned from England, where he investigated the process of producing the gas. He states that large steam plants are being wholly removed in order to make way for the introduction of Mond gas and the gas engine. In making this gas no coke is produced, but practically the whole of the coal is burned away by a minute supply of air and steam. Dr. Mond, the inventor, is able to use ordinary slack coal and to turn this into gas at so low a temperature as to obtain much more ammonia than can be got from the coal distilled for illuminating gas. This producing gas has no illuminating qualities, but is used principally for two purposes, namely, as a source of motive power in gas engines, and in the employment of furnace heat by the aid of regenerators. It is claimed that the sulphate of ammonia obtained will repay three-fourths of the cost of the coal used.

Sir Frederick Bramwell makes some interesting comparisons between the gas engine and the steam engine. With the best steam engine he estimates that only 14 per cent. of the energy of the fuel is utilized, while with the gas engine twice that amount can be obtained. Between the ordinary gas engine and the ordinary steam engine, the comparison is much in favor of the former. In a test made in Birmingham a few years ago the average consumption of eight steam engines was such as to give only about 4 per cent. of the fuel energy, whereas Bramwell contends that a reasonably good gas engine will give seven times this amount. He claims that the replacement of steam engines by gas engines would save four-fifths of the coal now consumed. Another point advanced in favor of the Mond gas engine is that the ammonia produced yields a money value of 4 shillings 6 pence per ton of coal consumed. If the results claimed by Bramwell can be obtained, producer gas may well receive the attention of owners of steam plants. One objection, however, to the Mond process is that it can only be applied economically in large establishments requiring not less than one hundred horse power. Another objection, and perhaps a more serious one, is that the gas is intensely poisonous and must be used with great care to prevent leakage.

An act governing the supply of this gas for power and heating purposes has been passed in favor of the South Staffordshire Mond Gas Company. The maximum price is fixed at three pence per 1,000 cubic feet to consumers requiring not less than 16,000,000 cubic feet per annum, and four pence to consumers requiring less than this quantity. The act places the minimum heating value of the gas at 125 British thermal units per cubic foot, and the gas must never contain more than 14 per cent. of carbon monoxide. If the consumer uses the gas for lighting purposes the company may cut off his supply.

Ocean Telegraphy.

THE recent achievements by Signor Marconi towards the transmission of messages across the Atlantic without the employment of wires has aroused intense public interest in that system of telegraphy, and placed it in the category of commercial possibilities. Marconi's success, if such it may be termed, has been speedily accomplished, as it was in the year 1895 that he first turned his attention to wireless telegraphy. From laboratory tests he gradually increased the distances over which the messages were transmitted until he has finally bridged, as it were, an ocean space of nearly two thousand miles. For military purposes wireless telegraphy has been found advantageous by all the leading nations of the world, including Great Britain, France, Germany, Japan and Russia. The Government of Canada has recognized its advantages by employing the system for transmission of messages across the Straits of Belle Isle. The longest distance covered previous to the trans-Atlantic experiments was 186 miles. This was from the Isle of Wight to Cornwall, England. Gradually the obstacles were overcome. Marconi claims to have removed the objection of want of privacy by tuning his receiving instruments so that the messages will respond only to the tuned instruments.

Marconi's success has been doubted by such electricians as Edison, Greely and others, but this is only what might be expected when it is remembered how much incredulity attended the laying of the first trans-Atlantic cable and the introduction of other inventions representing recent electrical progress. The achievement is such as should elicit both admiration and commendation from scientists and the public at large. Admitting that what Marconi claims to have accomplished in sending signals across the Atlantic to be true, the question at once suggests itself whether the system is commercially practicable. On this point no one can speak with certainty ; developments must be awaited. If it is found possible to devise some scheme of non-interference to prevent confusion, so that the messages may be received at the point intended, a long step forward towards its adoption for commercial purposes will have been made. The absence of such provision has so far been one of the greatest objections to all forms of space telegraphy. Another point that suggests itself is the possibility of interference from fogs, clouds or storms. If wireless communication across oceans should be found feasible, it would result in greatly cheapening the cost of communication, and would be found of peculiar advantage to Great Britain and her Colonies. It is somewhat singular that only within the past year Prof. Pupin, of Columbia University, has invented a system of telephony without wires, making it possible to converse over much greater distances than were considered practicable.

The Berlin & Bridgeport Electric Street Railway Company, Limited, has obtained a charter of incorporation, to construct an electric railway between Berlin and Bridgeport, Ont.

MARCONI'S TELEGRAPHY EXPERIMENTS.

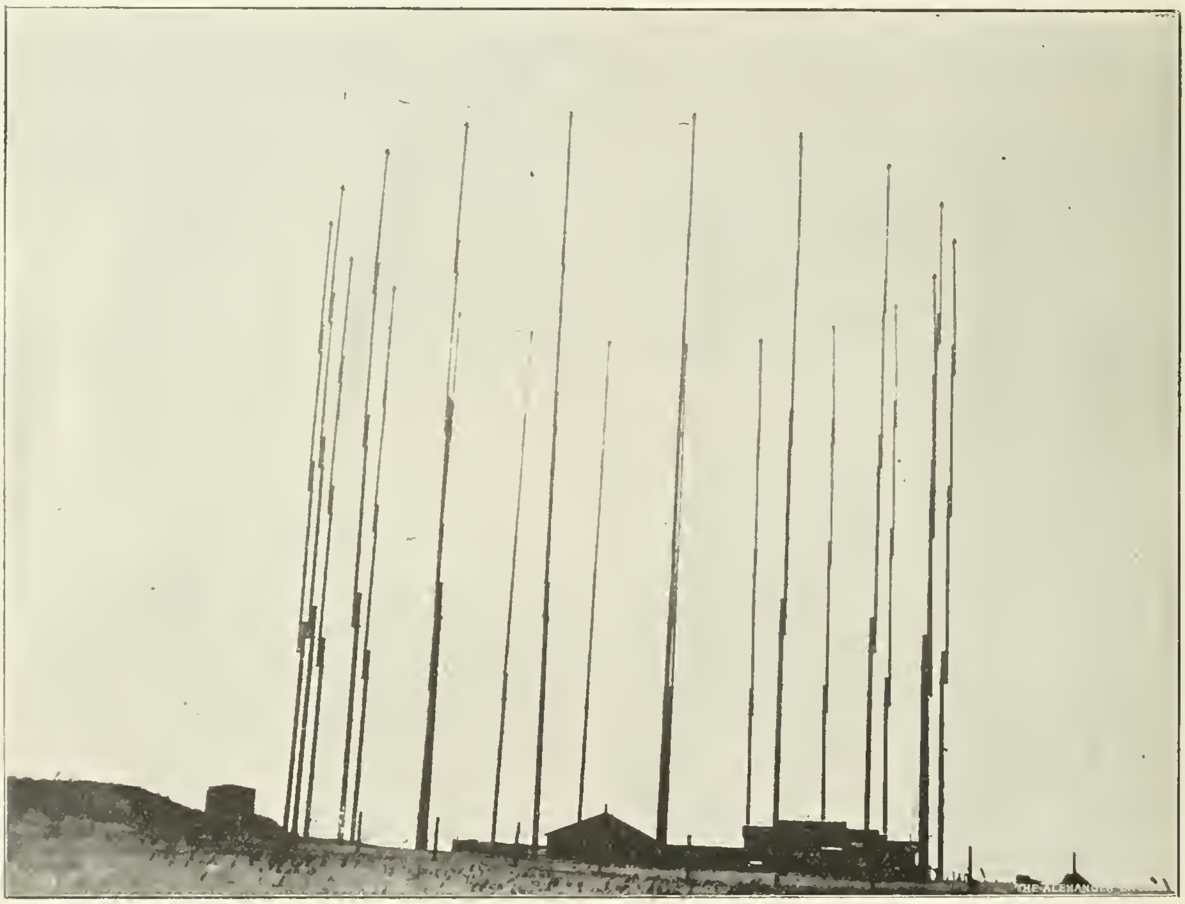
Signor William Marconi.

On December 15th the announcement was made by the press that Signor William Marconi had succeeded in transmitting signals across the Atlantic ocean without the use of connecting wires. At first there was much incredulity on the part of the public, but later details seemed to establish the fact that definite results had been achieved. Before leaving England Marconi had made arrangements to test the experiment. The two objective points were the Poldhu Station at Cornwall, England, and Signal Hill at St. Johns, Newfoundland, the distance between these two points being 2,100 miles. Marconi arrived at St. Johns on December 6th, bringing with him most of the essential apparatus for his experiments. Three days later he cabled to the Cornwall station orders to begin signalling according to a pre-arranged schedule, commencing at 3 p.m. daily and continuing until 6 p.m. During these hours Marconi elevated a kite with an ærial wire. He remained at the recorder attached to the receiving apparatus, and to his great satisfaction received signals at intervals under such conditions as assured him they were genuine.

The signals consisted of dots corresponding to the letters in the Morse alphabet, which is made by three dots or quick strokes. Again on Thursday, during the same hours, the kite was elevated and the same signals were renewed. Marconi states that he received the signals through a specially sensitive telephone attached to his instruments which enabled him to detect signals which the instruments would not record. The combinations were perfect though faint. Those received on Thursday were less distinct than those of the previous day. This is attributed to trouble experienced in keeping the kite elevated, owing to baffling winds.

At the station at Cornwall a large circle of twenty poles had been set up, each one of which is 150 feet high and bears an ærial wire. The electric force that is sent out from this transmitting station is said to be one hundred times greater than that at the ordinary wireless telegraph station.

When a permanent station is installed on this side Marconi will not be dependent upon fluctuations of the wind, and he is confident of making the signals strong and reliable, that is, not requiring such delicate and sensitive receiving instruments, by employing much greater power at the sending station.



View of Poldhu Station, Cornwall, Whence Signals were Transmitted.

Following the announcement of Marconi's success came an unexpected development. The inventor was served with legal documents from the solicitors of the Anglo-American Telegraph Company. These notified him that the company possess an exclusive monopoly to operate or construct within Newfoundland and its dependencies any system by which telegraphic communication can be obtained from any point in the colony to outside places. They demanded that he cease his experiments and remove his apparatus forthwith, otherwise the company would apply for an injunction restraining him from further tests. The difficulty has been referred to the London officials for negotiations, and it is expected that a satisfactory settlement will be reached. Meanwhile Marconi has temporarily ceased his experiments in Newfoundland and is said to have decided upon a point in Cape Breton from which to conduct further experiments and to have investigated some other sites with a view to erecting a permanent station. The Dominion Government have offered him every facility for erecting a station on the Nova Scotia seaboard. At time of writing the inventor is in the city of Ottawa conferring with the Government officials. He will then proceed to England to assist in the negotiations with the Anglo-American Company. It is reported that he expects to return to Canada early in the spring.

Harbor at St. Johns, Nfld—Signal Hill on the Left.

Guglielmo Marconi was born at Griffore, near Bologna, on April 25, 1874. His mother was English and his father was Italian. Since 1898 he has resided in England. In March, 1899, the first message by wireless telegraphy was sent across the English Channel, from South Foreland to Bologna, thirty-two miles distant. In the following summer the French naval vessel Vienne communicated with both France and England at a distance of 42 miles. A month later Marconi enjoyed the distinction of directing the manœuvres of the British fleet, sending messages more than eighty miles from one ship to another, and 130 miles through two ship stations. He subsequently came to America and successfully reported the international yacht races by his wireless system. His patents are controlled by the Marconi Marine Communication Company, Limited, and by the Marconi Wireless Telegraph Company.

MR. DWIGHT'S VIEWS.

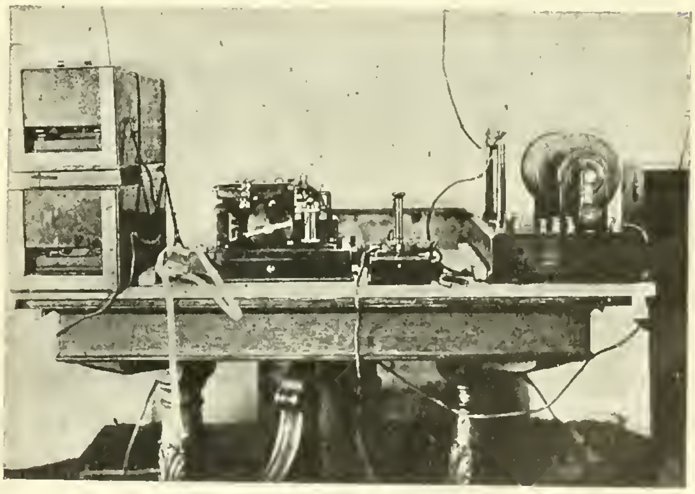
Concerning Marconi's experiments, Mr. H. P. Dwight, of Toronto, general manager of the Great Northwestern Telegraph Company, says :

"I learned a long time ago to believe that there was no limit to electrical development. I used to think there might be, but the older I get the more I am inclined to believe that this business of ours is in its infancy. The first Atlantic cable that was laid, 45 or more years ago, gave a little, feeble sign of life and expired. It was hardly more successful than this experiment of Marconi's in bringing a signal 1,700 miles across the Atlantic. It is well known, however, that the successful laying of that cable and the fact that it showed even a feeble sign of life gave confidence to enthusiastic promoters of cable telegraphy, and in due time capital was forthcoming for other cables, until there are to-day 14 Atlantic cables working regularly and successfully between America and the Old World.

"It can hardly be considered impossible or even unlikely that a similar development may take place in wireless telegraphy. It will take time, however, to do this. There are many difficulties to be overcome, but the best electrical experts in the world are alive to the situation, and it will not be their fault if wireless telegraphy does not become successful. When the telephone was first invented it was looked upon as simply a curious toy, and nobody ever dreamed of such a wonderful development of its use as we see to-day. I look upon the telephone as the most marvellous invention of the age. The wonder of it is overlooked in its familiar, every-day use. If it had been said twenty-five or thirty years ago that a time was coming in the near future, when a man seated in his office in Toronto could by means of a slender wire and an electrical current, hear his friend in New York and recognize his voice as clearly as if he were on the other side of the table ; or could, by like means, see him as plainly as if he sat before his eyes, such statements would have been looked upon as equally absurd and impossible. Yet, one of these is to-day a familiar thing, and the other is known to be theoretically possible, and not at all unlikely may become a common occurrence.

"I am reminded of an anecdote of Lord Kelvin, who visited, incognito, an electrical establishment where he was shown through by a young man, who expatiated at great length upon all the wonderful matters in connection with the establishment with an air of the greatest possible confidence, evidently intended to impress the visitor with the idea that he knew it all. When he got through, Lord Kelvin asked him, 'Can you tell me what electricity is?' The young man hesitated, and was speechless when Lord Kelvin added, 'I think that you and I know very little about it.'

"Wireless telegraphy cannot be said to be a new discovery. Electricians long ago discovered the sympathy between wires, say, on opposite sides of the street ; and they have been experimenting to see how this could be increased. Sir William H. Preece, the electrician of the British Post-office Department, has been experimenting for many years, and greatly increased the distance over which messages could be sent without wires. Marconi and others have simply expanded this idea, increasing distances, until now it would seem that a signal, at least, has been successfully sent over the Atlantic, a distance of about 1,700 miles. These experiments are not going to cease, and



Marconi's Standard Apparatus.

it is increditable to suppose that there will not be great advances in this direction.

"Meantime it is but right to say that cable companies and telegraph interests are not greatly alarmed as to any immediate injury to business from wireless telegraphy. Whatever may be the success of the latter, there will always be abundant scope and use for all existing systems."

MARCONI'S ACHIEVEMENT.

By D. H. Keeley,

Superintendent Dominion Government Telegraph Service.

When a man gets his name up for anything he does or has in hand, he finds himself liable to answer for many things straightway ascribed to him that he never dreampt of in his philosophy. To Mr. Marconi many things have been ascribed in advance of his actual achievements. He has so far never taken the trouble to warn the enthusiasts who indulge in these imaginings against their going too fast. But after all that is the only thing he could warn them against; for in the course of events one anticipation after another has been fulfilled as a natural consequence or a foregone conclusion of the wonderful work he is engaged in. Anyone being persuaded of this at the time the startling announcement was made of the attainment of trans-Atlantic signalling by the wireless telegraph, would naturally await confirmation of the report from the head centre. This confirmation is to hand. The writer has had it direct from Mr. Marconi himself since his arrival at Ottawa. There was a pre-arranged signal at a given rate from a costly transmission station at Cornwall, in England. When the perpendicular conductor at the coast of Newfoundland was elevated by balloon to a certain height, the receiving apparatus caught the expected waves and "hundreds and hundreds of them at the pre-arranged rate were received for several hours continuously." And, as the writer was given to understand, the concurrence of the transmitted and received signals was established by cable messages exchanged at the conclusion of the trial. All, apparently, that remains to be done is to duplicate, on this side of the Atlantic, the plant that is in operation in England; then messages can be sent to and fro, and the adaptation of the Marconi system for spanning the seas will be demonstrated.

A great deal of fuss is being made over this remarkable achievement from the point of view of its bringing the two continents into communication. If that was all there is to it, Mr. Marconi would not long be remembered, because it's an old thing, and he would only have found a second way of doing what we now do and will do for years and years to come with the submarine wires. What Marconi has done puts it in our power to keep in touch with every ship that sails to sea. These vessels, needing only the requisite and now available equipment, can be in touch with both shores at all times. There need not be more than one line of communication. Mr. Marconi promises a lot of them to be obtained by means of an harmonic elaboration of his system. To my mind, one line would be enough. The more important ships at sea would be akin to the numerous offices on an ordinary long line of telegraph in the open country districts where the business of each office is small. In the aggregate, it is a very large business—and it pays; but there is, nevertheless, not enough of it to occasion the stringing of second wire on the poles. So then, the single line of wireless communication embracing the seas would answer all requirements. It will create a new condition of things in the business of ocean travel and operations on the seas and must incidentally increase the work of the submarine cables immensely.

With increased traffic there is, of course, the possibility of the trans-Atlantic cable tolls being made lower than they now are, so everybody will be the better off and none will have occasion to regret the advent of the distinguished inventor who is so conspicuously instrumental in bringing it all about.

Ottawa, January 6th, 1902.

QUESTIONS AND ANSWERS

"Dynamo": I would like a little more information than your reply to "Ambition" conveys in your November issue, about electrical heaters. I am running a small municipal alternating plant (1,000 x 52 v.), and would like to make the operator's room (10 x 12) a little more comfortable during the night. I have power and current to spare, and plenty of large galvanized iron wire. I am not particular as to efficiency, heat being the object, and if you could without taking up too much space explain the construction of a serviceable article it would be a favor. Must a transformer be used, or can it be run off the primary? My exciter is a 25 lighter (110 v.). Could it be run off that? Is the heat created by induction or direct? Are the two leads connected with the two terminals of one coil without danger of short circuit? If a cut-out or junction box is used, what size should the fuse wire be? What is the best way to wind non-inductively, or is non-induction absolutely necessary? If a case is used, what kind, and would an old "Babcock" do?

Ans.—It is not possible to give you very much information in the limited space available, but the following will give an approximate idea of how to set about the work, though you must remember that it is not possible to give exact figures, the results obtained varying very much with the arrangement of the room and the material used, ordinary iron wire especially varying very much in its composition and consequently its resistance. You must also bear in mind that the underwriters are likely to object to anything not the product of some well-known manufacturer. In addition to the iron wire you will need two pieces of 1 inch pine, eight inches wide, the length varying from 8 to 10 feet, depending on the gauge of your wire and the size of the mandrel on which you coil it, sufficient ⅛ inch sheet asbestos to cover one side and the two edges of these boards, approximately 20 square feet, and about 25 square feet of wire netting, ⅜ inch mesh, and screws, glue and small staples. Glue the asbestos onto the boards, so as to completely cover one side and both edges, and after coiling the wire onto a 2 or 3 inch mandrel, staple it along the centre of the covered side of the board, taking care to stretch it so that there is a space of about ¼ inch between each turn. Assuming that you have a No. 8 wire, we would suggest that you coil up about 325 to 350 feet, and after connecting one end to one of the 52-volt transformer terminals, temporarily connect the other transformer lead to various points along the coil until you get a heat which keeps the room comfortable. Do not let the wire get too hot or it will sag and get out of shape, and also will gradually burn away. After you have found the proper length, which can only be determined by experiment, the wire netting should be put on as a protection; it will be necessary to cut it into strips and bend it to a half circle before tacking to place. It should be kept about two inches clear of the coil at all points. It will take two heaters of this kind to keep a 10 x 12 room of ordinary height at a good temperature, connected in parallel across the 52-volt secondary of the transformer. It would not be safe to connect heaters across the primary, the danger from shocks and the increased fire risk being too great, nor would it be practicable to run them from the exciter, as it has not got enough capacity. The heat is generated directly in the wire which carries the current. We do not think you will be much troubled with self-induction in a heater of this shape, difficulty being experienced only when the wire is confined in an iron case. Heaters built as above will require about a 40 ampere fuse wire for each; they should be mounted 12 or 18 inches from the floor, so as to get a good circulation of air round them.

"C.K.B." writes: When gravity batteries are set up new, how long a time should elapse until they are in good working order, and how long should they last before renewing cleaning zincs, adding blue stone, etc.? 2. Are the Crowfoot zincs called zinc electros? 3. Does a galvanometer register the strength of the battery, or simply show that there is a current on the line. The kind I speak of is simply a cheap compass on top of a small coil of wire. 3. Would circuit being open cause gravity battery to waste zincs, blue stone and strength of solution, more than if they were on circuit? In testing specific gravity with a glass bulb affair, I think they call it a Hydrometer, should the bulb rest on the blue solution, or should it stand up on the whole solution? What should it register? When my battery was new it sank until the bulb was on the blue solution and the top of the glass tube was almost under the water.

Ans.—(1) A gravity battery is in shape to operate just as soon as set up, provided you have used zinc sulphate round the zinc, instead of water, and that your copper sulphate is a saturated solution. The time they will last depends very much on the service they perform and the temperature of the room; we would say under ordinary conditions from say 3 to 6 months. 2. Yes, the Crowfoot zincs are called zinc electrodes. 3. It really shows the presence or absence of current, but as the deflection is dependent on the current strength, and the external resistance being constant, the current strength varies with the voltage and resistance of the battery; it is under this condition of constant external resistance, a more or less reliable indication of the strength and condition of the battery. 4. The battery will last longer if closed through a circuit of moderately high resistance than if left on open circuit. The use of a hydrometer is scarcely necessary except you desire to be very exact; the battery ought to do good work if the zinc and copper plates are clean, the zinc sulphate solution weak and the copper sulphate saturated, extending about an inch above the copper plate. The solution can be kept saturated by keeping a few undissolved crystals of the bluestone always in the bottom of the jar.

"Fireman": What is a surface blow off?

Ans.—It is a cock or valve, usually used in connection with boilers, placed at or a little below the usual water level, with a mouth extending into the boiler of dished or pan shape, so as to easily collect all grease or scum floating on top of the water, which blows off into the outer air if the cock be opened. This surface blow off is, of course, in addition to the usual blow off valve, connected as nearly as possible to the lowest point in the boiler.

"Ambition": What is the meaning of the terms consequent pole and salient pole.

Ans.—A salient pole is one whose magnetism is produced by one set of windings; the flux through consequent poles is made up of two or more fluxes generated by two or more coils.

"Subscriber, Montreal": Can you inform a reader (1) What is the action of the Wenhault interrupter when used in feeding Rhumkoff coils with A. C.? (2) Why does platinum tip get burnt off electrode in interrupter so easily?

Ans.: (1) The principle of this instrument is that the current flow produces a gas by decomposing the acid surrounding the electrode, this gas as soon as formed insulating the electrode and thus stopping the current flow. As soon as the current ceases the gas disappears and the circuit is closed, this cycle of operations repeating with great frequency. When used with alternating current the instrument has to be synchronized or tuned with the frequency of the circuit. (2) It is difficult to say why your platinum is burning away too quickly without seeing the instrument in question; perhaps you are trying to operate too large a coil from it.

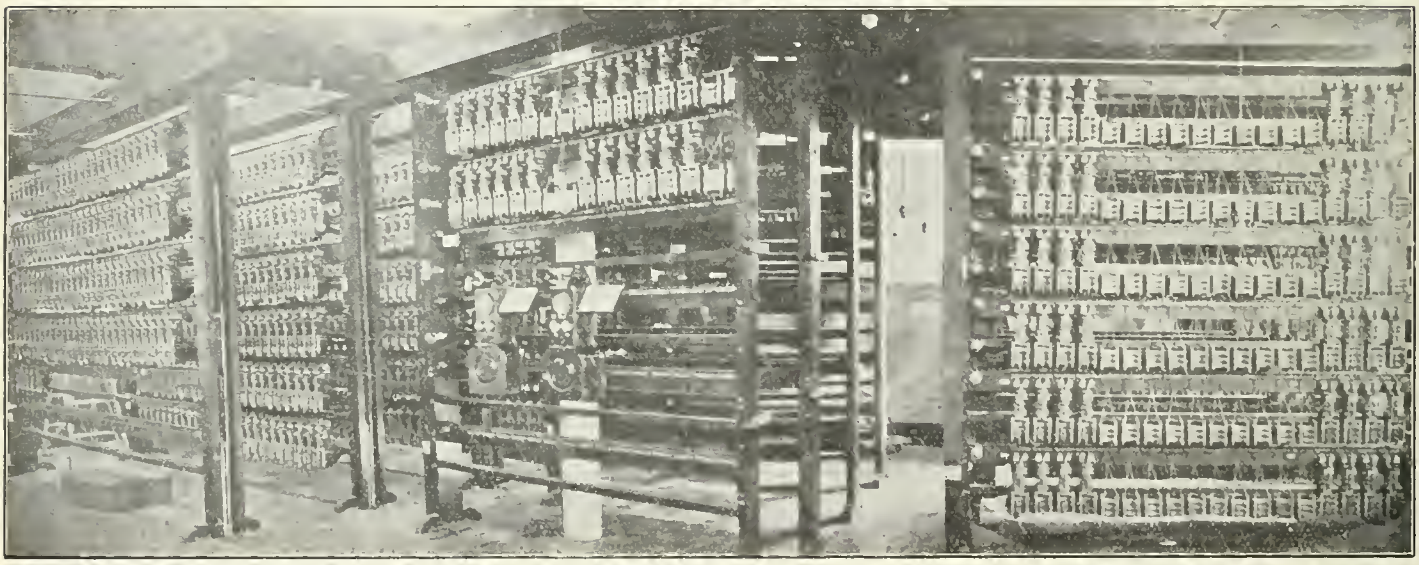
"E. S.," St. John, N. B.: In a communication received lately referring to two special makes of chain hoists, one is described as being capable of lifting the same load with the same energy in one half the time. Is this not contrary to well-known mechanical laws?"

Ans.: The same load, by which we presume you mean the same weight through the same distance, moved in one-half the time, means that the actual power output is twice as large in the short time operation as in the other, and since the energy delivered to the two hoists is the same, this in turn means that the losses in the slower hoist are at least twice as great as those in the other, or in other words that its efficiency is not greater than 50 per cent. of the efficiency of the other one. From the above you will see that the statement in your question is true under certain conditions, but it is most extremely improbable that those conditions will ever be found in practice, because the efficiencies of all hoists manufactured by reputable houses, those of about the same capacities being compared together, will not vary more than a comparatively small percentage, a discrepancy of 10 per cent. being the very outside that one would expect to find.

A SUCCESSFUL AUTOMATIC TELEPHONE EXCHANGE.

At Fall River, Mass., there is now in successful operation an automatic telephone exchange, using the Strowger system and handling the business of nearly 600 subscribers. The exchange, says the Electrical Review, was built by a local company under license from the Eastern Automatic Telephone Company, of Boston, and represents the most modern and complete installation of automatic telephones in the United States.

The difference between automatic exchanges and manually operated exchanges consists in the entire suppression, in the former, of the services of a third party in making connection between two subscribers. By automatic means any subscriber is enabled instantly to connect himself with any other and also automatically to disconnect both lines when his conversation is finished. By an ingenious application the calling subscriber is prevented from interfering with the line already in use and is notified that the called party is using his telephone. The method adopted to secure this result is one of extraordinary ingenuity and interest ; and while the complexity of the system is apparently very great, yet it is due simply to a multiplication of similar parts in themselves simple and, as has been proved in practice, reliable in their operation.



FIRST SELECTORS. SECOND SELECTORS. CONNECTING SELECTORS.

FIG. 1—THE AUTOMATIC TELEPHONE SWITCHBOARD AT FALL RIVER, MASSACHUSETTS, SHOWING FIRST, SECOND AND CONNECTING SELECTORS FOR A TOTAL OF 1,000 LINES, WITH 564 LINES CONNECTED AND IN SERVICE.

The system at Fall River comprises an exchange and a full metallic system of circuits to the subscribers distributed over a large portion of the city and its suburbs. The wiring from the exchange to these subscribers is carried out underground in twisted-pair cables of the "conference" standard, made by the Standard Underground Cable Company, of Pittsburg, and laid in conduits of the American Vitrified Company's type. In the outlying districts of the city the lines are overhead, of the usual construction, cables being carried on poles to distributing boxes and circuits run thence by aerial wires to the subscribers' premises. In its external details the wiring for this exchange is precisely similar to that for any metallic-circuit exchange system using a manual switchboard ; the difference is found in the subscribers' instruments and in the exchange itself.

The subscribers' station contains, besides the usual bells, transmitter, induction coil, battery and receiver, the selective calling apparatus, which is mounted in a box about the size of the usual telephone magneto. On the front of this box is a disc of metal, having along the edge on one side ten holes numbered consecutively from 1 to 0. By inserting the finger in one of these holes the disc may be turned, a stop placed at the lower part limiting the distance to which it may be turned with the finger in any given hole. To call a number the subscriber first removes the receiver from its hook and inserting his finger in turn in the holes of the proper number, turns the disc until his finger is stopped at the bottom, then releases it, and lets it go back to its starting position. Having turned up the proper numbers in this way he presses a button which rings the called subscriber's bell, and if the called line is not busy proceeds with his conversation. If the called line is busy, upon listening in his receiver, he hears a buzzing sound notifying him of this fact. Calling requires one second or less for each number.

The operation of the calling device is very simple and will be explained below. The subscribers' lines entering the exchange terminate in the usual lightning arresters and heat coils and pass thence through a distributing rack to a bank of selectors shown in the first illustration. Each line is connected with one of the selector machines, which occupies a space of about four by five inches in plan and ten inches high. The selector switch consists of 100 contacts, ranged in ten rows of ten each, mounted on a semi-circular structure, occupying the axis of which is a vertical rod adapted to be moved vertically and rotated. Better to explain the system in use the method of connecting an exchange of 100 or less subscribers will be described first. In this case each subscriber's selector is connected with all the others. The first movement of the calling subscriber's step by step selecting disc, which he operates in calling, picks out the "ten" and the next movement the "unit," this being very simply accomplished by sending in the first selective signal over one side of his two-wire circuit and the other signal over the other side, in both cases the ground being used as a return for the signaling current. Assume that the subscriber called is No. 63. The first movement to the figure 6 on the calling disc will result in stepping the vertical rod of his selector up six steps, or so that the wiping contact arm which it carries is opposite the beginning of the sixth row of contacts. The second movement to 3 will revolve the selector switch three steps, leaving the wiping contact on the third point on the sixth row and thus connecting the subscriber with telephone No. 63. This connection being accomplished, the caller pushes a button to ring the bell of he called subscriber and conversation proceeds. Should the latter, however, be already connected with some other telephone, then by a simple relay mechanism an interrupted battery current is thrown on the line of the calling subscriber, producing an unmistakable audible signal which informs him that the called line is busy. When the conversation is finished, hanging up the telephone of the caller sends current over both his lines and releases the step by step mechanism so that his selector on the switchboard goes back to its initial position ready for another call.

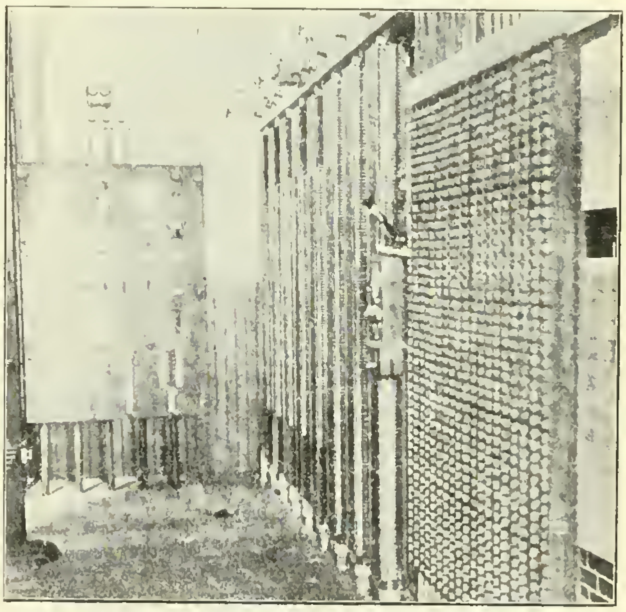
The extension of this system to an exchange having between 100 and 1,000 subscribers is exceedingly simple. In this case the first signal made instead of selecting the first digit of the called number directly connects the calling line to one of ten or more trunk lines, all of which lead to groups of instruments containing 100 in each. For example, if the number called is 546 the first signal sent in will pick out one of ten lines leading to the fifth group of 100 and the next two signals will select from this group the telephone number 46 in it, giving the desired call. For exchanges to have between 1,000 and 10,000 subscribers, as in Fall River, the first two signals pick out first the thousand group, then the hundred group in which the called number is found.

It has been found in practice that ten of these trunk lines are sufficient for each 100 subscribers, as the apparatus is automatically selective and proceeds to pick out a trunk line which is not busy, passing over those which are occupied without stopping. If none of the ten lines is in use the first signal sent in by a calling subscriber will stop on the first of the lines. If this happens to be in use the instrument automatically proceeds to the second one, and so until one line of the group not occupied is picked out. In the rare instance where all ten are busy, the result is simply that the calling subscriber gets the busy signal.

Current for operating all of the signalling mechanism and the bell ringing is generated at the central exchange in a battery of thirty storage cells, which are charged at convenient intervals through a battery-charging motor-dynamo from the local electricity supply mains. For working the selector signals, direct current of about 0.1 ampere is used, while for bell ringing an alternating current is provided by the usual motor-generator set. To attempt a detailed description of the numerous ingenious points of this system would carry this article beyond its limits, and reference can be made here only to a few of the salient features of the system.

It will be noted that all of the contacts employed, except the relay used in closing the bell ringing circuit through the called subscriber's line, are of the wipe-contact type, thus insuring good contact and minimizing the ill effects of dust and dirt. No conversation is ever carried on through an abutting contact, all of the contacts in the talking circuit being of the wire variety. Only two wires are run to each subscriber, and the apparatus for calling and signalling is of the central energy type, all of the current generating and converting devices being at the exchange where they are under supervision. The apparatus at the subscriber's station is no larger than that employed by other telephone systems.

The advantages claimed for this automatic system are numerous and important. Perhaps foremost is the rapidity and certainty with which connections may be made. In a test of numbers called at random at Fall River, made by a representative of the Electrical Review recently, the longest time required to ring the called subscriber's bell was seven and one-half seconds, while the average of a number of such calls fell below five seconds. Service like this is, to say the least, unusual. Another advantage that such a telephone system possesses is that it imposes the responsibility for a wrong connection upon the calling subscriber and puts in his hands, as it were, the mechanism of the exchange to work quickly or slowly, accurately or inaccurately, as he pleases. In this way a fruitful cause of complaint is abolished, while at the same time service is actually bettered. The secrecy of the service is, of course, a highly valuable feature, as is the impossibility of interruption or disconnection during a conversation.



POWER SWITCHBOARD. CABLE TERMINAL BOARD. DISTRIBUTING BOARD

POWER, TERMINAL AND DISTRIBUTING SWITCHBOARDS IN THE FALL RIVER AUTOMATIC TELEPHONE EXCHANGE.

From the point of view of the exchange itself the difference is even more marked, since the automatic system, while experience with it so far shows that the maintenance costs are practically the same as those for a manual exchange, saves the large fixed charge due to the wages of operators and attendants. In the Fall River exchange there are employed, in addition to the usual bookkeeper, collector, etc , only one attendant in the switchboard room, two inspectors and two linemen, and these spend much of their time installing new telephones. During the night and on Sunday the exchange is locked up and left to take care of itself.

Referring to the illustrations it will be seen that the space occupied by apparatus competent to take care of 999 subscribers, at Fall River, is no larger than that required for even a cramped manual exchange of the same capacity, while no provision has to be made for retiring rooms, etc., such as are found in the usual telephone exchange. Two-thirds of the installed switchboard has a capacity for 2,700 lines, the other portion requiring only additional sections to complete the exchange of that number. By the use of the trunking system the number of connections necessary to make on the switchboard and to maintain in the central office has been reduced considerably below that required for a multiple switchboard, there being necessary for each subscriber's circuit only seven connections to be made when the apparatus is installed on the board. The other connections are made at the factory when the instruments are manufactured and are, of course, there made under conditions best adapted to ensure their permanence and reliability. As the large illustration shows, the connecting cables are run in wooden troughs over the racks carrying the selector mechanisms, this construction making an exceedingly neat and simple arrangement of the exchange wiring.

The exchange opened service in September, 1901, with 400 subscribers, the actual number connected on November 9, 1901, being 590. It has given great satisfaction to its subscribers, who speak unreservedly in praise of it. The company comprises among its stockholders many users of the system, and, so far as may be judged from an external inspection, has achieved a very full measure of success in the installation and op ration of its most ingenious system.

ELECTRICITY DIRECT FROM HEAT.

By James Asher.

There are several methods of obtaining electricity from heat without the use of any working fluid such as steam or gas used in engines to drive dynamos.

The thermo-electric battery consists in a set of strips of either unlike metals or of alloys whose alternate junctions are heated while their opposite junctions are cooled. Mr. Tesla told the writer that it is impossible to obtain an efficiency of more than two per cent. from a thermo-electric battery. On another occasion he said that the low efficiency of the thermo-electric battery is not its greatest defect, but the fact that the junctions of the metals become greatly impaired. Mr. Cox invented a battery in which he claims that the latter objection has been overcome. During construction the elements are melted together.

A battery consisting in a set of iron cups containing carbons and caustic potash are set over a furnace. Experiments with this battery led many to believe that electricity could be generated with economy from the heat of burning coal. Mr. C. J. Reed made a number of experiments with this invention which satisfied him that it is really a thermo-electric battery.

A pyromagnetic generator was invented in 1887 by Mr. Edison. It consists in a number of horizontal field magnets whose poles point towards a vertical shaft. Facing the poles of the magnets are several compound vertical armature tubes of iron only one two-hundredth of an inch in thickness. The upper ends of the tubes are fastened in a thick iron disk, while their lower ends are fastened in a similar disk. The iron disks serve as pole pieces for the field magnets. The armatures are wound with insulated wire, which is led to a number of brushes, which press against a commutator. Instead of having two brushes and many commutator bars, this machine has many brushes and two commutator bars. The shaft bears a semi-circular disk of fireclay on its lower end. When rotated in a proper manner the disk successively screens the lower ends of the armature tubes from the upward passage of hot furnace gases. During the passage of hot furnace gases throughout the tubes these lose magnetism, but while their lower ends are screened they become cool and gain magnetism from the field magnets. The successive magnetizations and demagnetizations of the armatures cause the generation of electric currents in the wires wound on the armatures. The commutator arranges the currents so that a continuous current flows in the external circuit. The machine is mounted on a furnace which resembles a coal stove. Mr. Edison said that a pyromagnetic generator weighing two or three tons would supply thirty incandescent lights, each of sixteen candle power. In regard to economy he said that experiment proved the invention to be more economical than any other method of generating electricity.

POWER DIRECT FROM HEAT.

A pyromagnetic motor was invented by Mr. Edison in 1887. The largest machine weighs fifteen hundred pounds and yields about three-horse power. It has a horizontal bipolar field magnet between whose pole pieces are an armature composed of a great many iron tubes each only one two-hundredth of an inch in thickness. The armature has a vertical shaft. Two earthenware guides, one above the upper end, and the other below the lower end of the armature, guide cold air into and out of about one-half of the armature tubes. A broad segment of the armature is always being cooled, while the two outer segments are always being heated by hot furnace gases which are blown up through them. The cold air during its passage through the tubes, while cooling them, becomes raised in temperature. This air is led below the burning coal. By means of this regenerative device an economy in heat is effected. The earthenware guides are stationary and are dissymmetrically set in regard to the field magnet. The parts of the armature which are red hot refuse to carry magnetism, while the cooler part carries them freely. A distorted magnetic field is set up which causes rotation of the armature. This machine has the following faults:— 1. It is heavy. 2. The armature can run no faster than 120 revolutions a minute. 3. Alternate heating and cooling cause the failure of the thin iron tubes. 4. These narrow tubes are very liable to become clogged with soot and ashes.

Pyromagnetic motors and motor generators were invented by M. Menges, of the Hague, in Holland. His pyromagnet motor has a vertical shaft. Fastened near the armature ring, so as to rotate along with it, is a corrugated sheet iron ring. A group of gas jets is set at about 45 degrees from the middle of the pole piece of the permanent field magnet. Diametrically across the armature is a similar group of gas jets. The gas jets heat successive parts of the thin iron annular screen while it and the armature rotate. The screen is cooled by two blasts of air diametrically across the armature from each other. The red hot parts of the screen permit the passage of very few lines of force, while the cool parts permit the passage of many lines of force from the field magnet to the armature. A distorted magnetic field is set up which causes rotation of the armature and the screen which it carries.

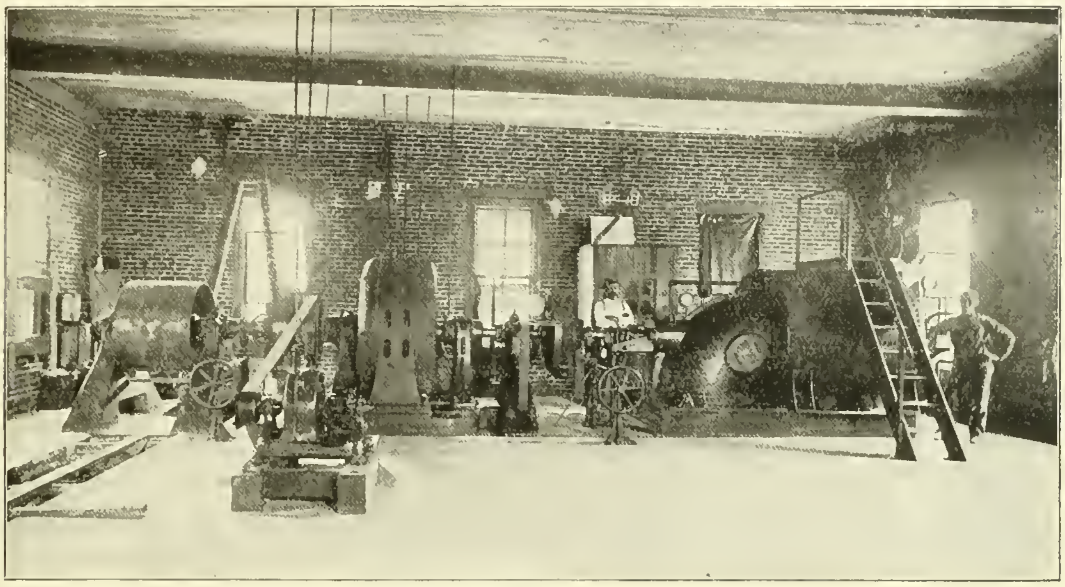


Fig. 1—Power Transmission Plant in Washington.

M. Menges' pyromagnetic motor generator is similar to his motor just described, but the armature has a gramme winding and there are brushes and a commutator. The field magnet is wound with wire, and the machine is self-exciting. Part of the current may excite the field magnet while part may supply electric lights. Part of the energy may at the same time be used to drive machinery directly connected to the shaft. Menges' machines have the faults of Edison's, except No. 4.

The motive power in pyromagnetic motors and motor generators is due to heat energy. Magnetism is used as a convenient means of transmitting energy from burning fuel to the armature.

POWER TRANSMISSION PLANT IN WASHINGTON.

In the generating station of the Walla Walla (Wash.) Gas and Electric Co. is installed the new dyro-electric plant illustrated herewith. The plant was put in operation in May last, and up to the present time, we understand, has given 24 hour service without interruption. The water is conducted from a near-by stream through a wooden stave pipe line, 5,600 feet long and four feet in internal diameter. The water wheel is 27 inches in diameter and is operated under a head of 90 feet. It is direct-connected by a friction clutch to a 300 kilowatt, monocycle generator. The wheel is a McCormick turbine, built by the S. Morgan Smith Company, of York, Pa., who furnished the hydraulic equipment. The electrical installation was made by the General Electric Company. Fig. 1 well shows the general arrangement of the power machinery. The generator is of the revolving-field type and is operated at 450 revolutions per minute. The end thrust of the wheel is taken care of by lignum vitae steps, one set in the wheel case and the other in the discharge pipe. The wheel is fitted with a Replogle relay governor, as shown in Fig. 2. At the left end of the driving shaft will be seen a wide-faced pulley which is connected to the generator by a friction clutch. This is to provide connection for a 400 horse power steam engine which is not shown in illustrations. The engine is installed only as auxiliary to be used in case of accident to the water power. The plant is situated five miles from centre of distribution.

The Royal Electric Company have notified the city council of Montreal that it is their intention to immediately replace the street lamps now in use with those as specified in the new contract. It is expected to replace one-half of the number now installed during the year 1902, and the remainder during the following year.

In 1897 the Citizens' Light & Power Company contracted for the street lightning for ten years of the municipality of St. Louis, a suburb of Montreal. In May, 1901, the council decided that the Citizens Light & Power Company was not furnishing a satisfactory light, and on this ground gave a 15 year contract to the Royal Electric Company. As a result the two systems have been in operation ever since, and the Citizens' Company have entered an action to secure the payment of $26,000 for light furnished for one year.

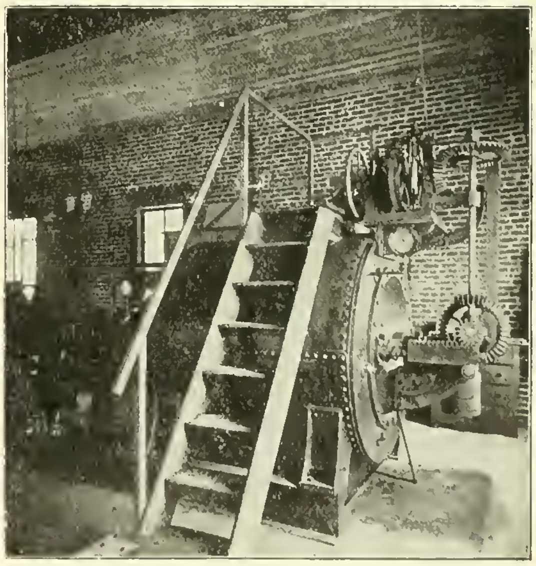


Fig. 2—Power Transmission Plant in Washington.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,
MONTREAL, January 6, 1902.

The Montreal Street Railway have at last relieved the pressure on the Windsor route by opening their recently well built line up Beaver Hall Hill, and running west on St. Catherine street. This is a capital business men's route and should be appreciated, especially as it is equipped with the long double truck cars, built on the Scotch plan, with the entrance in the centre. The hot air heating apparatus (another improvement over last year's coal stoves) is located near the motorman, but as it does not reach the rear section, this is heated electrically by radiators placed under the seats.

The Montreal Gas Company's metres and those of the Royal Electric Company are now being read by the same staff, one of the outcomes of the new Montreal light and power combine. The idea is certainly a very good one for the company, although it may have the result of dispensing with some employees who may now be found superfluous.

A lighting company, and an Ontario one at that, write a prominent one here as to their views on free wiring! Now, while this is well in its way, we would suggest that they not only "throw in" the wiring, but a Waterbury watch, or a pound of tea. As far as Montreal goes, with some 50 aspirants for wiring honors in the field, the lighting company don't seem to hanker for a business which is already so "fine" that it is hard to get three meals a day on the profits thereof.

The inspection, wiring and line superintendents of the Royal Electric Company have now all been removed from their former offices, corner Queen and Ottawa streets, to quarters in the Montreal Street Railway Building, whilst the clerical staff, treasurer, etc., have taken up their abode with the Montreal Gas Company in the New York Life Building.

The Christmas season could not be called a busy one locally in electrical circles. Supply men, wiring contractors, etc., were rather quiet, and the lighting companies could have stood a few more connections. Usually things flatten down for the winter after New Years, but this year has seen the date advanced by a fortnight.

Mr. J. Bell, the efficient and well-known inspector for the Canadian Fire Underwriters Association in Montreal, has resigned his position with that body, to accept a similar one under the Ottawa Fire Insurance Company, who, we are informed, are not in the Fire Underwriters Association. Mr. Bell's decisions as to alterations in existing installations were generally carefully considered, and those who have met him will wish him success in his new position and a wider scope of action electrically. By the way, Mr. Bell, take a glance for a change at "outside wiring and connections." You will find a rich field.

The Stanley "magnetic flotation" recording watt-meter adopted by the Royal Electric Company and later by the Lachine Company, seems to fill a long felt want apparently, as both companies are short of meters and awaiting the filling of their orders. It is said the Stanley Company have orders for 80,000 on hand. This seems scarcely credible, but even if approximate, the company must be doing a marvelous business, considering that it is virtually a new comer on the market—not to speak of the other specialties which they manufacture.

The accident on Chenneville street, in this city, reported lately, where "primary" wires came in contact with some "dead" secondaries, but which unfortunately were still connected with transformer, being only one tap of several secondary taps from same transformer, shows the necessity of the entire removal of service wires right back to mains (or transformer) when service is discontinued. It also teaches that all unlined sockets still existing in cellars with cement or earth floors should be at once eliminated. But for above circumstances the death of the furnace attendant who lost his life apparently through holding the socket and opening the furnace door at the same time with the other hand, might not have occurred.

A switchboard attendant named Lieper got himself severely burned on the side of the face and ear by an arc when opening a high tension switch (10,000 volts) lately at the Royal Electric Company's station. It is said there was a short-circuit on the line at the time, and Lieper went to open up the switch.

The apparent "scheme" of trying to influence the stock market by announcing a "deal" between the Lachine Company and the Montreal Light, Heat & Power Company as tried by a lay evening contemporary, proved a signal failure. Mr. Walbank, the managing director of the Lachine Company, not only promptly denied the statement, but added that the option of purchase on the basis of two dollars for every one dollar invested has expired, and the price will now be higher.

It is said that Mr. W. H. Browne, Montreal, late general manager of the Royal Electric Company, will go to Great Barrington Falls, Mass., to accept the position of manager for the Stanley Electrical Instrument Company. Mr. Browne was a prominent member of the Order of the Knights of Columbus when in Montreal.

It is rumoured that Mr. Hounald, of the Lachine Rapids Company, will shortly sever his connection with that company. The fraternity will be sorry to hear this, as Mr. Hounald is a general favorite. He has the satisfaction of knowing that the Montreal boys will miss him, but wish him every good luck in his new sphere where'er it chance to be.

PERSONAL.

Mr. Charles A. Henderson, of the B. Greening Wire Company, Hamilton, has completed the electrical engineering course in the American School of Correspondence, Boston, Mass., and has been awarded a diploma.

The marriage was celebrated last month of Mr. William F. McLaren, electrical engineer of Pittsburg, son of Lieut.-Col. Henry McLaren, of Hamilton, to Miss Houston, daughter of Ven. Archdeacon Houston, of Niagara Falls. Mr. and Mrs. McLaren will reside in Pittsburg.

Mr. H. P. Dwight, president and general manager of the Great Northwestern Telegraph Company, on December 23rd last celebrated the 73rd anniversary of his birth. From all points of the Dominion and the United States he was the recipient of telegrams and letters of congratulation.

In consequence of Mr. Hartley Gisborne having removed to Ladysmith, Vancouver Island, he has resigned the hon.-secretaryship for Canada of the Institution of Electrical Engineers, London, England. The council of the Institution has appointed Professor R. B. Owens (McGill University, Montreal) in his place. Mr. Gisborne succeeded Prof. Carus-Wilson as hon.-secretary for Canada in 1897.

The following appointments have been made in connection with the management of the Montreal Street Railway and the Park and Island Railway: Mr. D. Robertson, assistant to the general manager; Mr. H. J. Kennedy, superintent of the road, with charge of traffic arrangements on both the Montreal and Park and Island systems; Mr. W. Punt, assistant superintendent and foreman of car shops at Hochelaga; Mr. H. R. Lockhart, superintendent of the power house and overhead-work on both systems; Mr. J. S. Vindin, engineer in charge of permanent ways, buildings and bridges; Mr. H. G. Taylor, mechanical superintendent.

We are pleased to learn of the appointment of Mr. O. P. St. John, of Toronto, as surveyor for the British Corporation for the Survey and Registering of Shipping. This corporation is a rival to the great Lloyds, of London, England, its purpose being to register and classify vessels so that they will be accepted as risks by the insurance companies. Mr. St John will have charge of all vessels in the Great Lakes rated by this company. The British Corporation are fortunate in securing the services of Mr. St. John, as he is well versed in marine matters, and will doubtless look after their interests with entire satisfaction. He will, of course, continue to act as inspector for the Boiler Inspection and Insurance Company.

The town of Annapolis, N.S., will borrow $12,000 for the purpose of extending the electric light plant and operating it by water power.

Messrs. Downham & Hastings, electricians, have registered partnership in Montreal, as have also McDonald & Rivest, in the same business.

ENGINEERING and MECHANICS

TO FIND THE LENGTH OF BELT REQUIRED.

In a recent Wood-Worker an enquirer asked several questions concerning the duties of a millright. One of them was, how to find the proper length of a belt after the distance around the pulleys is known. If the pulleys are up the simplest way is to take a tape line and put it around the pulleys the same as you would the belt; whatever the tape reads that length your belt should be.

If you can not do this there is a simple rule to go by (for a straight belt). Suppose the distances between the centres of two shafts is 14 feet, the diameter of one pulley 8 feet and the other 4 feet, and the thickness of the belt ¼-inch. Then half the circumference of the 8-foot pulley is 12.5664 feet and half the circumference of the 4-foot pulley is 6.2834. Three times the thickness of the belt is ¾-inch or .0625 feet. Then 28 plus 12.5664 plus 6.2834 plus .0625 equals 46.9103, or 46 feet and 10 15/16 inches is the length of your belt. Therefore, the rule for a straight belt is this: To twice the distance between the two centres add half the circumference of each pulley, with three times the thickness of the belt.

To find the length of a cross belt the rule is more complex. First, the distance from the center of each pulley to the center of the point where they will cross must be obtained. If both pulleys should happen to be the same diameter, the cross will occur exactly in the center of the space between them. If not, then that point will be in proportion to their respective diameters and may be found by the following rule: Divide the diameter of the larger pulley by that of the smaller and add 1 to the quotient. This will represent the number of parts into which the distance between the centres is supposed to be divided. Then as the whole number of parts taken by the larger pulley, so is the whole distance between the centres to the point where the cross will occur. Example: A pulley 8 feet diameter is to drive one of 4 feet with a cross belt ¼-inch thick, the distance between the centres being 14 feet. Required, the distance to the point where they will cross and the whole length of the belt.

First find the point where they will cross by the foregoing rule: 8 divided by 4 equals 2, plus 1 equals 3. This represents that the 14 feet are supposed to be divided into three parts, and as the diameter of the same pulley is contained in that of the larger one twice, it shows that two parts of the three must be taken by it—3 is to 2 as 14 is to 9 feet 4 inches. Now, as the whole distance is 14 feet and the larger pulley requires 9 feet 4 inches, the distance from this point to the smaller pulley is 4 feet 8 inches, so that the distance from the center of the large pulley to the point where the belt will cross is 9 feet 4 inches, while the other from the same point will be 4 feet 8 inches.

If a horizontal line be drawn through the center of each pulley, extending from one to the other, and a perpendicular line also drawn through the same points, intersecting it at right angles, there will be two rightangled triangles formed, the base of one being 9 feet 4 inches, with a perpendicular equal to the radius of the 8-foot pulley, or 4 feet, while the other base will be equal to 4 feet 8 inches, with a perpendicular equal to the radius of the 4-foot pulley, or 2 feet, the belt in each case representing the hypothenuse; and as the square root of the sum of the squares of the base and the perpendicular of any right-angled triangle equals the hypothenuse, it is evident that the hypothenuse of these two figures must represent the length of belt between these two parts.

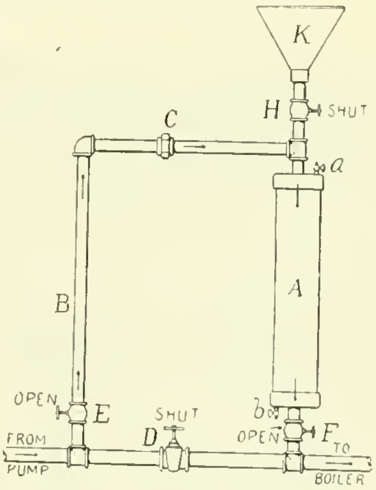
The operation perhaps will be more simple and easier understood if the whole be reduced to inches. Then 112 times 112 equals 12,544 inches, and 48 times 48 equals 2,304 inches, being the square of the base and perpendicular in inches. Then 12,544 plus 2,304 equals 14,848, the square root of which is 121.85 inches. With the other proceed in like manner: 56 times 56 equals 3,136, and 24 times 24 equals 576, and 3,136 plus 576 equals 3,712, the square root of which is 60.92 inches. Now if each of these sums is doubled and half the circumference of each pulley with three times the thickness of the belt be added together, their sum will be equal to the whole length of belt required in inches, which, when reduced to feet, will be found to equal 48 feet 1½ inches.

INTRODUCING SOLVENTS INTO BOILERS.

We are often asked by engineers and others how to introduce scale solvents, such as soda ash, into a boiler. We took up this question at some length in the issues of The Locomotive for July and August, 1888, when we showed two very convenient arrangements for pumping the dissolved solvent into the boiler, and also a method of introducing it by means of an injector. These different methods ordinarily work very well in practice, but we have occasionally had complaints to the effect that the soda ash, when passed through the pump, eats out the packing thereof. We think this would hardly be likely to occur with a new packing, but with an old one, which had become impregnated with oil or grease, the soda ash might easily give some such trouble as has been reported.

To assist those who have had difficulties of this sort, we present, herewith, another plan for introducing the dissolved solvent, by means of which it is forced into the boiler without passing through the pump at all. The present arrangement calls for more piping than the ones previously shown, and its only advantage is that it saves the pump.

Referring to the illustration, A is a section of big pipe—say 6 inches in diameter and 30 inches long—which is to serve as a reservoir. This connects with the feed pipe running from the pump to the boiler, by means of the pipes B, C, and F, which are so arranged that they connect the feed pipe on opposite sides of the stop valve D. Over the reservoir is a funnel, K, by means of which the reservoir, A, can be filled through the valve H. The reservoir, A, is provided with pet-cocks, a and b, at the top and bottom, so that it may be readily filled and emptied. A union is provided at C, to facilitate the assembling of the piping. (A right-and-left elbow, of course, may be used instead, if it is preferred.)



Arrangement of Piping for Introducing Solvents.

The device is used as follows: The reservoir A being empty, valves E and F, and pet-cock b, are first closed, and valve H and pet-cock a are opened. The soda ash solution is then poured into K, until the reservoir A is filled. The valve H and the pet-cock a are then closed, as well as the valve D, in the main pipe. Valves E and F are then opened, and the pump is started. The device is then in the condition shown in the engraving, and the water from the pump passes through B, C and A, as shown by the arrows, sweeping the contents of A out into the boiler.

When the pump has been run long enough to thoroughly remove all soda ash from A, valve D may be opened and valves E and F closed. The reservoir A is then emptied by opening pet-cock b and either pet-cock a or valve H, and the device is again ready for operation.—The Locomotive.

TORONTO NO 1, C. A. S. E.

The regular meeting of Toronto No. 1 was held on Wednesday, December 18th, president W. J. Webb in the chair. The meeting was thrown open, when Bro. A. M. Wickens, chairman of the Educational Committee, introduced Mr. Bigger, editor of the Canadian Engineer, who gave a talk on "The Metric System of Weights and Measures," after which the speaker was elected an honorary member of the association. Bro. C. Moseley and A. M. Wickens were elected representatives on the Technical School Board.

SPARKS.

The recent vote in Milton, Ont., on municipal control of electric lighting was 118 for and 39 against.

A new switch-board has been installed in the central office of the Bell Telephone Company at Toronto Junction, Ont.

The Hudson's Bay Company have recently added another combination engine and motor to the electric plant in their Winnipeg stores. Other improvements are being made.

A by-law was defeated by the ratepayers of Hagersville, Ont., on January 6th, to provide a municipal electric lighting plant.

It is said that the Lachine Rapids Hydraulic & Land Company, of Montreal, will issue bonds for $1,500,000 with which to erect a new steam plant.

Major Armstrong, of Toronto Junction, is advocating the extension of the Toronto Suburban Railway to connect with the Metropolitan Railway at Yonge street. He thinks that this would be the means of building up a large market for farm produce at Toronto Junction.

The Crescent Electric Company, of Montreal, has been incorporated, with a capital of $100,000, to install electric light plants and do a general electrical business. The charter members include Messrs. L. Rousseau, of St. Louis, and Maurice Rousseau, of Montmagny, Que.

The Cape Breton Electric Company are about to commence the erection of their new power house at Sydney, N.S. It will be 61 x 100 feet, so designed as to be enlarged to three times this size. There will be a car barn 80 x 160 feet. One thousand horse power in engines will be installed primarily.

The Phoenix Oil Company, of Cleveland, Ohio, manufacturers and dealers in lubricating oils, graphite greases, etc., have opened Canadian offices at Room 25, Janes Building, corner King and Yonge streets, Toronto. This firm make a specialty of Murphy's famous Green Seal belt dressing. Mr. P. R. Hood is manager and Canadian representative.

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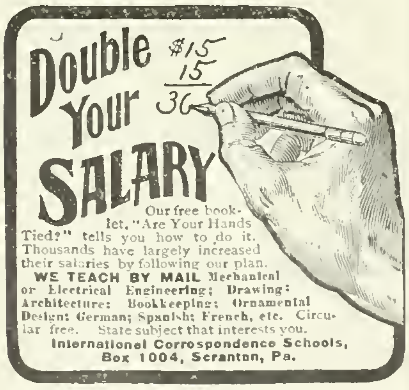

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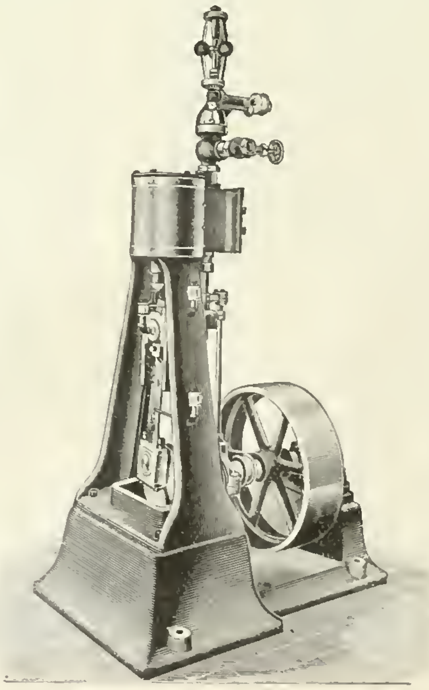

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CANADIAN
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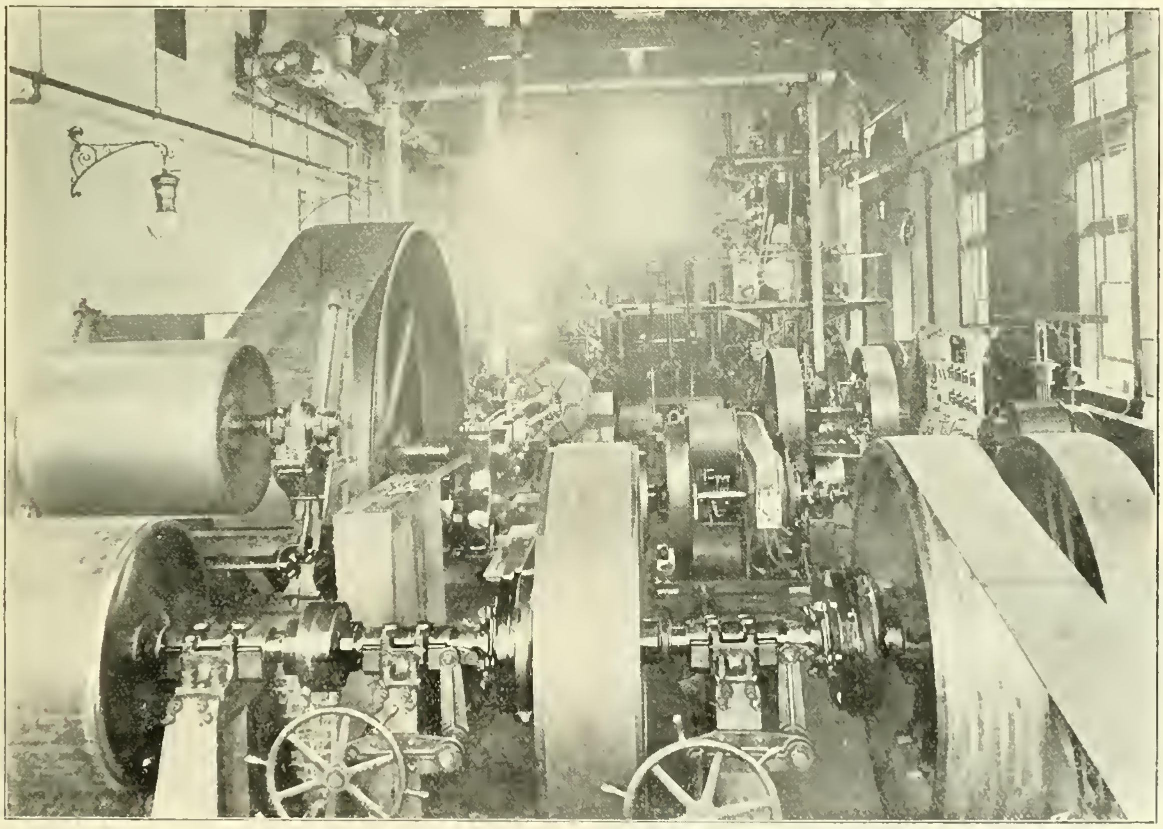
VOL. XII. FEBRUARY, 1902 No 2.

WINNIPEG LIGHTING AND PUMPING PLANT.

In the summer of 1899 a municipal plant for electric street lighting and for pumping purposes was installed by the corporation of Winnipeg, under the supervision of Mr. James Stuart, Water and Light Commissioner. The electric light plant and waterworks pumps are located in one building, shown on the following page, which is a stone structure 94 feet long, 36 feet wide, and 26 feet high clear inside, the pumps being located in the north end and only taking up about 25 feet of the length of the building. The balance of the floor space is occupied by the electric light plant. The boiler house is 61 feet long and 32 feet wide, with a brick chimney 125 feet in height.



INTERIOR OF POWER HOUSE—WINNIPEG LIGHTING AND PUMPING PLANT.

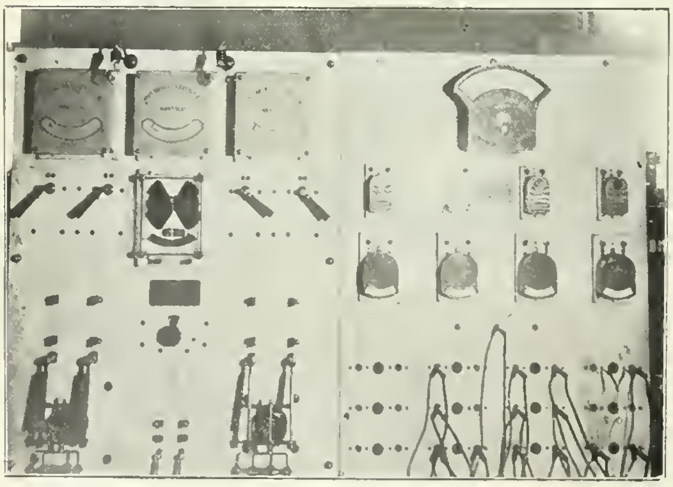
The steam plant consists of five Babcock & Wilcox sectional water tube boilers in two batteries of two boilers each and one of one boiler, having a rated capacity of 130 h. p. each, or 650 h. p. combined, at a steam pressure of 125 lbs. per square inch, with a total heating surface of 7,500 square feet and a total grate surface of 150 square feet. They are fitted with mechanical grates and stokers, which are driven by two 6 in. x 6 in. vertical engines. Water is supplied by two duplex Worthington pumps 6 in. x 6 in. x 7 in., and passes through a Bonner live steam feed water purifier before entering the boilers.

The power for electric lighting is derived from one pair of Brown automatic, horizontal, cross-compound surface condensing engines built by the Polson Iron Company, of Toronto, with Northey independent air and circulating pumps. The sizes of engine cylinders are, high pressure 18 inches diameter, low pressure 32 inches diameter and 42 inch stroke, operating at 80 revolutions per minute. The fly wheel, which is the driving pulley of the engine, is cast in two halves, is 16 feet in diameter and 44 inch face, carrying a belt 42 inches wide which drives a steel centre shaft 6 inches in diameter and 8 feet long, to which is coupled a steel shaft 5 inches in diameter and 20 feet long. The main driven pulley on centre shaft is 4 feet in diameter and 44 inch face. There is also an adjustable belt tightener fitted with self-oiling bearings. The line shaft is fitted with four split, iron centre, friction clutch pulleys 60 inches diameter and 16 inch face, capable of handling 100 h. p. each. The bearings are of the adjustable ring-oiling type. All shafting, pulleys, bearings, etc., were furnished and installed by the Dodge Manufacturing Company, of Toronto, and have given perfect satisfaction.

Power House, Winnipeg Lighting and Pumping Plant.

Three of these pulleys are belted to three Western Electric arc dynamos, each having a capacity of 100 open arc lamps with a maximum output of 9.6 amperes and 5,800 volts operated at a speed of 650 revolutions per minute. The switch-board is of marble, bolted together through angle iron, which is fastened to the floor and wall in a substantial manner. The construction of this switch-board is such that the dynamos may be changed to any circuit or vice versa while the machines are in operation. Each dynamo circuit is supplied with an ammeter and polarity indicator. There is also one volt-meter suitable for indicating the voltage of any circuit. Each line is equipped with two single pole lightning arresters.

The street lamps are of the Western Electric Company's single carbon type. There are 240 in operation and they give a steady and uniform light. They are provided with automatic cut-outs which switch the lamps out of circuit when the carbon becomes consumed or when the arc for any reason becomes too long.



Incandescent Switch-Board. Arc Switch-Board.

Current is also furnished from this station for lighting all municipal buildings by one 60 kilowatt S. K. C. two-phase, alternating current generator, the switch-board for which is of marble and is equipped with two current indicators, one volt-meter and transfer switch, one volt-meter transformer, one ground detector, two main line switches, one exciter switch, one generator rheostat, one exciter rheostat, four magazine fuse blocks and two pilot lamps. The alternator is driven by a pulley on line shaft operated by large engines, but during moonlight can be operated by one Leonard Ball tandem compound, condensing, high-speed engine. The buildings lighted are the city hall, north, south and central fire halls, market building, police station, store houses and waterworks. The total number of lights installed is about 750.

The operation of the waterworks and electric light plant is combined, the boilers furnishing steam for both electric light and pumping engines.

The pumps in use are one set of Worthington compound, condensing, vertical pumping engines with a capacity of 5,000,000 gallons per 24 hours at 30 lbs. pressure per square inch on main. The engines pump the water from an artesian well and deliver it to the water softening plant, from which the water flows into a reservoir and is pumped from there to the city by one set of Worthington duplex, triple expansion, surface condensing, vertical pumping engines with a capacity of 5,000,000 gallons per day at 125 lbs. pressure per square inch on main.

Mr. James Stuart,
Water and Light Commissioner, Winnipeg.

A curious circumstance illustrating the difference in speed between sound, which travels through the air, and electricity through wire as its guide and conductor, occurred in California. A certain powder works blew up in a town while a railway telegraph operator was telegraphing to another in a neighboring town. At the instant of the occurrence he telegraphed the news to the operator, who, sixty seconds afterward heard the report of the explosion. He knew it had occurred by wire just one minute before he heard the report. Sound travels at about the rate of 1,140 feet per second, while electricity accomplishes 186,000 miles in the same short period of time. Exchange.

VISIT TO THE CORNWALL POWER PLANT.

Upon the invitation of Messrs. Collyer & Brock, of Montreal, Canadian agents for the Bullock Electric Manufacturing Company, Cincinnati, Ohio, a large number of interested persons visited the power plant of the St. Lawrence Power Company at Cornwall, Ont., on January 11th. The party were carried by special G. T. R. train from Montreal to Cornwall, where, after a thorough inspection of the plant, luncheon was partaken of. The electrical apparatus for this important power development was furnished by the Bullock Electric Manufacturing Company. A description of the plant will appear in our next number.

CAUSES OF LOSS OF CURRENT.

OTTAWA, ONT., Jan. 8, 1902.

Editor CANADIAN ELECTRICAL NEWS:

SIR,—Replying to your letter of 3rd inst. and post card of 4th, with reference to meters, we beg to say that our experience has been entirely different from what appears to have been that of the electric light inspection department.

It is a rare exception for a meter to be brought in after having been used on a customer's premises a considerable time and not to find it running slow, especially on small loads. Our meters are tested and carefully adjusted before they are sent up to the government for inspection, in order to save paying fees for nothing, consequently the inspector finds them correct, with very few exceptions. I do not see how it can be otherwise, except with small companies who do not adjust meters at all, but depend upon the government inspector to tell them when meters are wrong, and even then I should think there would be a preponderance of slow meters. In comparing notes with other companies, I have always found their experience to be similar to ours as to slow meters. It would be interesting to know what the actual figures were from which the electric light inspection department compiled the records which led to their statement.

Yours very truly,

A. A. DION,

General Superintendent Ottawa Electric Company.

VISITORS TO THE POWER PLANT OF THE ST. LAWRENCE POWER COMPANY, CORNWALL, ONT., JANUARY 11TH, 1902.

SHERBROOKE, QUE., Jan. 6th, 1901.

Editor CANADIAN ELECTRICAL NEWS:

Sir,—Your letter of the 3rd to hand. Would say that it would entail quite a bit of labour for us to make a record of the difference between the station and the consumer, seeing we have no meter in the station, simply our common instruments on the switchboard. We have also quite a few customers on flat rates and many other difficulties which I believe other companies have, and I don't see how any company can keep or make such comparison.

With regard to meters found to run fast when tested, I believe a few of the Shallenberger which we used two years ago were found to be on the fast side but passed. The meters we now use, the Stanley watt meter, is exactly right every time, and after two years hard use, are found to be the same as when tested. I believe the general run of meters are set at first to run fast, as they soon get slow enough, but that is the exception with the Stanley meter, it keeps exactly right in our experience. We have now in our small works about 250 of them, and everyone has been correct when tested. I may say that the companies who put out meters generally make them on the fast side. As I was led to believe when on a visit to several works in the States last fall, it was with the view of making up for the lagging or slow going which soon appeared in the meters—after a few weeks' use. I trust you will not imagine that I am an agent for the Stanley meter, but I simply give my experience, and also the experience of several electric companies in the New England States who are now using them and have been for two years—putting out several other makes. The inspectors I believe will find in that meter an instrument which will show a good record, and will I believe make a more correct showing for those companies whose difference is so much between the station and the customer.

Yours very truly,

A. SANGSTER,

Superintendent Sherbrooke Gas & Water Company.

TORONTO, January 9th, 1902.

Editor CANADIAN ELECTRICAL NEWS.

Sir,—I have yours of January 3rd., referring to the statement in the Electrical World that electric lighting companies in the States are only able to deliver from 60 to 68% of their energy as generated to their customers. Taking the majority of plants I should suppose that this is not an excessive statement. It is altogether likely that the theoretical efficiency of even a first class plant under most favorable conditions would involve a loss of at least 15% in line resistance and the various converting devices, but when you consider that nine-tenths of the time an electric lighting plant is working under uneconomical conditions, that is to say, with generators and transformers very much under full load and during the whole time when a plant is in operation, whether any current is being delivered to customers or not, the loss on the transformers is just the same.

If a new plant is put in on the best modern lines with everything up to date and properly calculated for the amount of work it is to do, the loss would not be any more than as above stated. Most plants, however, are the product of a gradual growth and the machinery, lines and transformers have been added to from time to time, as occasion has arisen, and very often in a temporary manner. Nothing but a complete rebuilding of the plant, involving the destruction of the original investment, and a complete new outfit, would bring some of these stations up to full efficiency, and it is a great question whether in most cases the interest on the cost of this new outfit would not be more than the loss by the uneconomical working of the old. In some cases it might be, but it is altogether a question of local conditions and the circumstances under which plants are operating.

With reference to meters: I am perfectly satisfied that more meters run slow than run fast, and that the loss from this source is considerable. There is also a considerable leakage and loss where the company's lines extend over a large area and run into buildings where there are a number of tenants who constitute a floating population and also a certain amount that the companies are cheated out of by dishonest customers.

I think the reason that the Government Inspector finds more meters fast than slow, amongst those that are sent to him by the customer for re-verification, is that this is the result of outside parties' interference with the meters, who make approximate tests and only select those meters for re-verification which are found to be fast. When they find slow meters, or when the customers have reason to believe their meters are slow, they do not shout very loudly.

Yours truly,

J. J. WRIGHT,

Manager Toronto Electric Light Co.

MR. WM. H. BROWNE.

The Montreal daily press brings us the information that Mr. Wm. H. Browne, who for the past seven years was General Manager of the Royal Electric Company, has severed his connection with them, taking effect January 31st, 1902, and was elected a member of the Board of Directors of the Stanley Electric Instrument Company, of Great Barrington, Mass., and at a subsequent meeting appointed General Manager and Treasurer, his term of office beginning February 1st, 1902.

Mr. Browne's connection with the electrical industries is rather unique, and dates back to 1888, when he built the electric railway in Richmond, Virginia, which, if not the very first, was one of the first electric railways in the United States, and on which much of the pioneer electric railway work and experimenting was done. Following this he became associated with the Westinghouse interests in New York City, and as General Manager of the United Electric Company, was in charge when the first alternating current, high tension generators—2000 volts—were installed, and the distribution of light from them began. At that period it was considered murderous to install systems of such high potential, and many are the curious yarns he can regale his friends with as to the awful consequences predicted from their use.

Mr. Wm. H. Browne.

Curiously, from New York his next move was to Montreal, to the Royal Electric Company, where one of his first moves was the changing of the entire lighting system from 1200 volts to 2400 volts, and the installation of a polyphase system of current for power and lighting purposes, both of which were very radical departures, at the time, from what was then considered good practice, but which is in almost universal use now.

The Chambly Manufacturing Company about this time, 1897, began the development of the hydraulic power on the Richelieu river at Chambly Rapids for the purpose of transmitting the power to Montreal by electricity, a distance of about 16 miles. Here the novel feature of generating within the machines 12,000 volts, so that step-up transformers were not necessary, was for the first time put in practice and successfully carried through. Although later on changed to a lower voltage and step-up transformers, yet the example set in this work is being carried out in the largest power generating and distributing plants in this country and the United States, where it is a common practice now to generate a pressure of 6,600 volts.

The following year the company completed the works of the Cataract Power Company, of Hamilton, who are carrying 10,000 H. P. nearly 40 miles, at a pressure of 24,000 volts, which was at the time of its installation the largest transmission and the highest voltage in practical use in North America, if not in the world.

The past year was spent in Montreal, the principal event being the turning over to the Canadian General Electric Company, of the manufacturing business of the Royal Electric Company, which was built up under Mr. Browne's careful management, and which is now being actively carried on by the first named company.

The consolidation or community of interest between the Chambly Manufacturing Company, the Royal Electric Company and the Montreal Gas Company, under the name and title of the Montreal Light, Heat and Power Company, with a capitalization of $25,000,000, was his last work in Canada, and completed the largest industrial organization in the Dominion.

It seems but fitting that, having been in the van since 1888, the latest and most radical departure in electrical engineering devices should be captained by him, and we most heartily wish that prosperity shall continue with him in his new position, and his every effort be crowned with success.

While Mr. Browne was at the fore and front, and progresive in business matters, and while we may miss his leadership, yet more will he be missed among those who had the pleasure of knowing and coming in contact with him personally. Genial, broad-minded and fair, he was a friend to everybody, and once met never to be forgotten. His connection with the Canadian Electrical Association during his residence in Canada was the most active, serving two years as President, and made him friends innumerable, and though he may never meet with us again, his works will live after him, and his hearty laugh and genial good fellowship will ever live in the memory of those who knew him.

Mr. J. Laine has transferred to the Belgian Syndicate, of Shawinigan Falls, his franchise for an electric railway from Three Rivers to that place.

QUESTIONS AND ANSWERS

"Induction": (1) A three-phase generator has its rating as follows: 400 k. w., 382 amperes volts, no load 550 volts, full load 605. Step-up and step-down transformers are in use which step from 550 to 11,620 at the generating station, and 11,000 to 575 at sub-station. In order to receive 575 at sub-station the generator need only be run at 525 volts. Are we loading generator at full load capacity when we get 382 amperes at 525 volts, or may it be run at 525 volts till the output represents 400,000 watts? Give formula for calculating three-phase systems. (2) How can I make a volt-meter from 10 to 125 volts suitable for D. C. dynamo? What changes would be necessary to use it on A. C. at the same voltage?

Ans.: (1) The kilowatt output of your machine when run at 382 amp. and 525 volts is not, of course, the rated capacity of 400 k. w., but the heating due to the current load is the same as if the voltage were at its highest point of 605, but, since it will not require as much field current to give 525 volts as it will 605, the heating of the field and consequently of the machine as a whole will be slightly less under the lower voltage; or in other words, you may increase your load in amperes slightly, if you keep your voltage at 525, and get the same heating as with the normal current of 382 amperes at 605 volts. The current in a three-phase system is obtained by multiplying the single-phase current by .577, the k.w. by multiplying the single-phase k. w. by 1.732, or current $= \frac{577 \text{ kilowatts.}}{\text{voltage}}$ Kilowatts = current × voltage × 1.732. (2) It is not practicable for you to make a commercial instrument; it would cost you far less and be much more accurate if bought from a standard manufacturer. We presume you have one on your 500 volt alternator; if operated either through a potential transformer or an external resistance it could be connected to your direct current voltage which you want to measure by means of a small double throw switch.

"Anxious to Know," Montreal, writes: Would you kindly explain in your next issue how an induction motor may be made to work as a generator?

Ans.: You will have to drive it up to speed by some external source similar to any other generator, and then excite it by coupling it up with some other source of alternating E. M. F. It will not give any voltage, no matter at what speed it is driven, unless connected as above to an alternator.

"J. C.," Montreal, writes: Where was the first telephone exchange established in Canada?

Ans.: In a paper entitled "History of the Telephone in Canada," read before the Canadian Electrical Association in 1893, by Mr. L. B. McFarlane, we are told that Prof. Alex. Graham Bell, the inventor of the telephone, lived at Tutello Heights, on the outskirts of Brantford, Ontario, and it was there that his earliest experiments in telephony were made. The first experimental line erected in Canada extended from the residence of the inventor's father to the residence of Rev. Thomas Henderson in Brantford. The first commercial telephone line was established at Hamilton, Ont., in October, 1877, by the District Telephone Company, connecting together the residences of Messrs. Baker and Cory. Subsequently a number of private lines were erected in Montreal and Toronto. These lines formed the neuclus of exchanges in these cities which were first put into operation in 1878.

"C. D. M.," Sussex, N.B., writes: (1) Can you give me the actual or approximate cost per thousand gallons of water pumped up into a reservoir? Our pump is a simple, duplex, Worthington, capacity 2.25 gallons per minute. The reservoir is half a mile away on a hill. We pump direct into mains, the pressure at the station being 82 pounds, and when pump is running about 84 pounds. We have an 80 h.p. boiler, three inch tubes, bricked in, of Leonard make. Our coal costs in boiler house $3.50 per ton. (2) Please explain as fully as possible how Signor Marconi sends messages from one station to another through the air without wires.

Ans.: It is not possible to give anything but an approximate answer to your question, except by making an actual test. It must also be borne in mind that the figures given below cover nothing but the bare cost of the coal, such items as labor, depreciation and interest on investment not being included. A square inch of water 1 foot high weighs .433 lbs. Therefore a pressure of 84 lbs. per square inch gives a height or lift of $\frac{84}{\cdot 433}$ feet. A U. S. standard gallon of water weighs $8\frac{1}{3}$ lbs. Therefore, the foot minute lbs. output of pump is $8\frac{1}{3}$ (lbs) × $2\frac{1}{4}$ (gallons per minute) × $\frac{284}{\cdot 433}$ (feet lift) and the horse power is $\frac{8\frac{1}{3} \times 2\frac{1}{4} \times \frac{84}{\cdot 433}}{33{,}000}$ h.p.

Pumping at $2\frac{1}{4}$ gallons per minute, your pump will take $\frac{1{,}000}{2\frac{1}{4} \times 60}$ hours to pump 1,000 gallons. Therefore, the horse power hours necessary to deliver 1,000 galls. under 84 lbs. pressure is $\frac{8\frac{1}{3} \times 2\frac{1}{4} \times \frac{84}{\cdot 433}}{33{,}000} \times \frac{1{,}000}{2\frac{1}{4} \times 60}$

A pump such as yours, in combination with a boiler of ordinary efficiency, will produce a horse power hour on 12 to 18 lbs of coal, or say 15 lbs. Therefore, to produce the above horse power hours your pump will consume

$$\frac{8\frac{1}{3} \times 2\frac{1}{2} + \frac{84}{\cdot 433}}{33{,}000} \times \frac{1{,}000}{2\frac{1}{4} \times 60} \times 15 \text{ lbs. of coal.}$$

Since 2,000 lbs of coal cost $3.50 cents, the above number of pounds will cost

$$\frac{8\frac{1}{3} \times 2\frac{1}{4} \times \frac{84}{\cdot 433}}{33{,}000} \times \frac{1{,}000}{2\frac{1}{4} \times 60} \times 15 \times \frac{350}{2{,}000} \text{ cents.}$$

which equation resolved gives about $2\frac{1}{4}$ cents as the theoretical cost of the coal alone, obviously an extremely small percentage of the total, and utterly negligible among the other items of the cost. (2) It is difficult without going into a very long article to give you much information on this subject, but in brief the principle part of the apparatus consists of an instrument, called a coherer, which has the ability to receive or perceive the disturbances or waves produced in the air or ether surrounding the earth, by the passage of a spark between the terminals of an ordinary spark gap or induction machine. The high poles used at each end are for the purpose of giving to and receiving from the air the greatest amount of disturbance, or number of waves, that is possible. The coherer consists of a glass tube containing filings of various substances, iron and nickel being most commonly used, these filings being in circuit with a battery and a relay similar to those for ordinary telephone and telegraph work. Under ordinary conditions the resistance of this coherer is so great that no current will pass through it, but when a discharge from the sending instrument comes down the pole wire and through the filings they rearrange themselves so as to lessen their resistance enough to let a current from the battery pass through and operate the relay, which in turn operates some form of sounder or tape machine. The relay is so arranged that it mechanically taps the tube at the instant of operation; this parts the filings and they then assume their original position, ready for another discharge or signal. Mr. Marconi uses the standard Morse code of dots and dashes. A popular article on wireless telegraphy appeared in a recent issue of Maclure's magazine.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

Electricity v Acetylene.

The town of Lindsay has recently given a ten years contract for street lighting by acetylene gas. The acetylene company have laid down pipes on the principal thoroughfares, and undertaken to supply 125 lights of 150 c.p. each at the rate of $15.00 per lamp per year, and 6 1,500 c.p. lights at $35.00, at which figures it is believed they will be unable to realize a fair margin of profit. This is believed to be the largest acetylene plant in operation in Canada, and the results will be watched with interest. The citizens appear to be finding out, in the light of the competition of the new company, that the prices which they have been called on to pay in the past for electric light have been reasonable. It does not seem probable that acetylene will supplant the electric light for commercial purposes, but may possibly tend to show up to better advantage the superior quality and adaptability of electric light over acetylene gas as an illuminant.

Loss of Current.

A WRITER in the Electrical World states that in the United States electric light companies are only able to deliver to their customers from 60 to 68 per cent of the initial energy developed at their stations. The remaining 32 to 40 per cent. is said to be lost in transmission and in transformers and meters. Twenty-five per cent. of this loss is said to be chargeable to slow running meters. In view of the importance of this matter, from a financial point of view, to electric lighting companies, request was made of the managers of several companies in the cities and larger towns in Canada for a statement of their experience in this direction. Some of the replies received are printed in the present number. The subject is one which will bear further discussion, and a comparison of experience on the part of managers of companies, would doubtless bring out information that would be helpful to all. We therefore invite a further expression of opinion from electric light and power companies. Current costs money to produce and is the stock in trade of the central station manager. Loss of current is not only a direct loss of money spent for fuel and equipment, but also stands in the way of the development of electric lighting, the cost of which could be lessened and its popularity increased if loss of current could be prevented to a larger extent than at present.

The Extension of Foreign Trade.

THE suggestions made by a committee of the Canadian Manufacturers' Association to the Dominion Government regarding the extension of export trade should be heartily supported by Canadian manufacturers and the Canadian press. We may not all agree as to the particular methods to be adopted, but the necessity of taking steps to make our manufactured products better known in foreign countries must be universally admitted. The markets of the West Indies, for instance, are now very largely supplied by United States merchants. Very little is known of Canadian goods. It is claimed that New York houses already handle more Canadian goods in the West Indies than are shipped direct from Canada. The publishers of this journal recently received from a gentlemen at Hamilton, Bermuda, a request for a directory of Canadian wood-working firms and dealers in building material. This gentleman states that for materials for public works they are compelled to obtain estimates from the United States on account of not knowing where to apply in Canada. He adds that the Imperial Government Surveyor had applied to him for such a directory, and he was certain that such information would often lead to the placing of considerable orders that now go to the United States.

Toronto's Municipal Enterprises

There is reason to fear that the scheme to empower the city of Toronto to develop and distribute power for electrical purposes and to enter into arrangements with outside companies for that object, is the work of shrewd promoters who are naturally enough seeking to make their pile by a short cut, and that efforts are being made to induce the city's representatives to lend their support not altogether from the standpoint of custodians of the public funds. Some three or four years ago, the town of Austin, Texas, went into a power development scheme, with the result that the town is now bankrupt, and unable to pay for ether gas, water, or electric light. Toronto has also engaged in several undertakings, which though less disastrous, must be classed as failures, and which have saddled heavy and unnecessary burdens on the taxpapers. Under this head might be cited the Don improvement scheme on which three quarters of a million dollars were wasted; the alternative site for the C.P.R. on the esplanade which cost nearly a million and which is bringing the city no revenue and serving no useful purpose; the new city hall which was to have cost $750,000 and will actually cost at least $2,500,000; and the St. Lawrence market, which has already cost $50,000 above the limit of expenditure fixed when the by-law was submitted to the property owners for their approval, which when completed will only represent a part of the original scheme, and which seems likely to fail of its object, as the lesses of the old market refuse to move so far away from their present location. These and other undertakings are costly examples of municipal mismanagement, and give no encouragement to prudent property owners to allow themselves to be taxed for further experiments of a similar character. We have the peculiar spectacle of the chief promoter of the present scheme in the Council, urging the purchase by the city of the property of the gas company, and saying that gas is the coming thing, while on the other hand seeking to induce the city to become a stockholder in outside companies to develop and supply electricity. The city would not have a controlling interest in such companies and would therefore be dependent on their willingness to grant satisfactory terms.

Electric Lighting Companies vs. Municipal Corporations

A legal decision of much interest and importance to electric lighting companies is printed in this number of the Electrical News. The case is one of an action brought by the corporation of the town of Rat Portage, Ont., against the Citizens' Telephone & Electric Company ot that town, to have declared invalid a contract entered into by the corporation with the company for the supply of light, fire alarm service, etc. The corporation entered into a five years' renewable agreement with the company in 1899. The Council passed a resolution authorizing the acting mayor, in the absence of the mayor, to sign the agreement, and at a subsequent meeting, owing to the power of the acting mayor to sign the contract binding the corporation having been called in question, passed a second resolution confirming its previous action, and the acting mayor's right to sign the agreement in behalf of the corporation. As a condition of giving the contract to the company, the Council stipulated that the campany should forego payment of $50 per month for fire alarm service from 1st December, 1898, to the 11th of September, 1899. To this condition the company agreed. On making the agreement with the company, the corporation refunded the amount of $1,000 deposited by the company with their tender. For two years the company served the corporation under the agreement, and was paid for the service at the contract price, the amount so paid being included in the municipal estimates. At this stage the Council, seemingly as the result of personal animus against the company on the part of some of its members, brought action to set aside the agreement with the company on the ground that it was invalid, because no by-law authorizing it had passed the Council. Judge Britton, before whom the case was argued at Port Arthur, decided that, in view of the circumstances, the passing ot a by-law was not necessary to make the agreement binding on the municipality. He declared that the acting mayor who signed the agreement for the corporation was vested with all the powers of the mayor, and that the Council, by passing resolutions confirming the agreement, as well as by levying a special rate and paying the company for the service in accordance with the terms ot the contract, clearly acquiesced in the agreement. He further pointed out that the corporation had made a good bargain with the company and had received advantages which were acceded to by the company only on the understanding that the agreement should cover a period of five years and be renewable. On this understanding the company had also invested a large amount in new plant. It would therefore be manifestly unjust to the company to allow the agreement to be broken. We have heard a great deal during the last few years about the unjust treatment of municipalities by private corporations, but very little has been said on the other side of the question. The facts in the case under consideration are a strong evidence that, in some instances at least, there is a deplorable lack of honor on the part of municipal councils in their dealings with private corporations. While it is desirable that electric lighting companies should endeavor to work harmoniously with the Councils, there is necessity for the exercise of caution, especially with regard to terms of contracts, as is plainly evidenced by the experience of the Rat Portage company.

CANADIAN ELECTRICAL ASSOCIATION.

A meeting of the Executive Committee of the Association to make preliminary arrangements for the Annual Convention, was held at the Windsor Hotel in Montreal on the 10th of January. There was a full attendance. Mr. P. G. Gossler, President, presided. A number of new members were elected. It was decided that the Annual Convention should take place in Quebec on June 11th, 12th and 13th. Various Committees were appointed to carry out the necessary arrangements for the meeting.

A letter was read from Mr. Frederic Nicholls, General Manager of the Canadian General Electric Company, offering the sum of $500.00 to the Association to be applied as the Executive Committee might direct.

The Committee accepted the offer with thanks, and decided that the money should be set aside as a special fund, out of which will be allotted yearly a sum not exceeding $75.00, to be awarded in prizes by a Committee to be appointed for that purpose each year, to the author of a statement of his latest original investigation or development of the electrical art, or for paper or papers presented to the Annual Convention, which statement of original investigation so presented to the Annual Convention, or paper or papers, shall, in the opinion of the Committee to be appointed annually to judge thereof, be considered the most worthy and valuable of the series presented at such Convention. Such prizes to be awarded only to members of the Canadian Electrical Association.

A Committee was appointed to decide upon rules and regulations under which the prizes for papers should be awarded, and to the Committee on Papers was delegated the duty of judging the merits of papers submitted.

The President was requested to communicate with Mr. Francisco and ask that he include Canada in his statistics of the results of the operation of municipal plants.

Having learned of the presence in Montreal of Mr. Marconi, the Committee tendered that gentleman an invitation to an informal luncheon at the St. James' Club. Mr. Marconi very kindly accepted, and the Committee spent a couple of hours very pleasantly and profitably in his company.

Mr. Marconi has intimated his intention to attend, if possible, the Annual Convention of the Association at Quebec in June next, and to present at the Convention a paper embodying the results of his most recent scientific researches.

POWER AND ITS ECONOMICAL TRANSMISSION.

The important subject of "Power and its Economical Transmission" was discussed in an able manner by Mr. Henry Souther, consulting metallurgical engineer and state chemist, of Hartford, Conn., in a lecture delivered in the rotunda of the Board of Trade Building, Toronto, on January 16th, under the auspices of the Canadian Manufacturers' Association. Having the benefit of both practical and theoretical experience, Mr. Souther may be regarded as an authority on the subject. He treated briefly with the generation of power and then in more detail on sub-divisions. His remarks in part are given below:

Naturally the first thing to consider in connection with the subject before us is the source of power in an industrial establishment, and to determine the best source of power the only basis of comparison in these commercial days is that of cost.

The only power we can obtain for practically nothing is that from falling water. The cost of harnessing is considerable, but after that there is nothing to compare with water power for small cost. I expect to see the time—or at least I believe there will be a time, if I do not see it—when every waterfall will be utilized. This is becoming more and more possible with every addition to our knowledge of electricity. It is now not necessary as of old for a factory to actually overhang the stream from which the power is obtained; on the contrary, it is often better for it to be at a reasonable distance with only the generating machines at the canal or flume. Other things being equal, therefore, water power is best, for it is cheapest.

The only other commercial source of power is heat from coal or oil. The common form of reciprocating steam engine in its many forms of single and multiple expansion is at present almost universal, but it seems to me that a change from the reciprocating to the rotary is coming, our now popular type will become absolete, and the rotary type universally used.

This movement has made considerable headway in Europe and is beginning on this continent. The electric light company of my own city has put in the largest Parson's turbine (3,000 h. p.), which is running well and very economically as compared with the best reciprocating engines. Turbines of the De Laval type are creeping in very fast for small units of power, being better adapted to many small uses than any other machine. They are economical at all powers within their own maximum. The coming power, however, in my opinion, is that obtained from liquid fuel (oils) direct, perhaps from solid powdered fuel as well, or from either one gasified. We obtain power now in this way by so-called gas engines, more properly speaking combustion or explosive engines. As yet they are not always successful, but tremendous strides are being made in perfecting these engines and the number in actual use is now very large. All things considered, however, the best engine or other source of power for any given place or installation is not determined by its economy, its cost or the type, but rather by the combination of points that will contribute most to lessening the cost of production of a given article.

In the future we may look forward to the storing of power from the heat of the sun. This is now experimentally possible and is being accomplished in the sunny climate of California; but I do not think that any of you gentlemen would undertake to equip a new plant just at present and in this climate with its only source of power the sun. Many things more wonderful have been accomplished lately, but this scheme will wait until the commercial necessity for it arises, although it looks to me as if the present rise in the price of coal would hasten its coming.

Then, again, the man who professes to multiply power indefinitely by intricate systems of gearing or some other equally impossible scheme is not yet dead; I fear we must jolly him along, however, and let him down easy without counting him as a serious proposition. He is ingenious and interesting, but not profitable.

Having the power, how shall it be most economically distributed to the producing point? Means for doing this are multiplying fast through the development of electricity, gas engines and the use of compressed air. The various possible systems are in part as follows:

Steam engine driving shafting by gearing, spur or bevel.

Steam engine driving shafting by belts or ropes.

Steam engine driving electric generator transmitting power over a plant with but few, if any, belts or gear drives.

Steam engine driving compressor of air and transmitting power in pipes over a plant to many forms of tools and lifts.

Gas engines transmitting power by belt or otherwise.

Central gas generating plant distributing gas over a plant in pipes to many engines of small units.

Every engineer or factory manager has his own ideas about these methods, and I dare say every one is much in the right as to his own particular case, in regard to which he is necessarily well informed. No one of the methods is best for all cases. Each particular one must be studied carefully. Conditions are also changing rapidly, what may be best one decade may not be best the next. How rapid this change is is well illustrated by the following quotation from a most eminent engineer, made as recently as 1867, William Fairbairn. In discussing transmission, he said, in part referring to belt drive, at that time new and mostly used in America, while the gear drive was almost universal in Europe, "the advantages of straps (belts) are the smoothness and noiselessness of the motion; their disadvantages are cumbrousness, the expense of their renewal and necessity of frequent repairs. They are inapplicable where the motion must be in a constant ratio, because, as the straps wear slack, they tend to slip over the pulleys and thus lose time."

How little these things seem to bother us now, and how few gears there are as compared with belts, notwithstanding the faults of the belts, as expressed by Mr. Fairbairn. It is almost useles, it seems to me, to talk on such subjects as these, inasmuch as what one says becomes obsolete so soon. All one can do is to act quickly in establishing a plant; take that which is most applicable at the time, and charge off each year enough from the machine account to buy all new in ten years at the longest. Above all things, in laying out a plant, no matter how small, do not proceed by rule of thumb, but think the entire arrangement out and plan it to scale on paper, determining the speed and position of every shaft and pulley; providing for everything beforehand. By other methods much work is repeated, and never as well done as it it might be.

The most lively discussion has always followed when the question of electric transmission has come up for consideration in all our engineering societies. Its exclusive use is advocated by some. By others it is absolutely condemned. The intermediate course will be the final one adopted. For certain work it is incomparable. For example, the large printing presses of to-day may be better manipulated by separate motor than by belt drive from main shaft. Entire independence of speed, reverse, repeated trials of the print, stopping and starting, and finally the cleanliness, make the motor drive directly connected, almost essential. The government printing office at Washington has materially reduced the expense and increased the product by the adoption of the motor drive throughout the place.

All machines served by overhead cranes should be motor driven so that the crane shall not meet the interference of belts. The printing press is one of these. All shops where groups of machines are run independently of other groups should be equipped with motors for each group. As a rule it is well to equip all heavy machine tools with independent motors, inasmuch as such tools stand idle much of the time. The plants in cotton and woollen mills need not be equipped with motors, unless perhaps, certain floors and departments are often run alone or are frequently shut down when the remainder of the mill is in operation. Anything that will do away with heavy and long belts will prove a commercial advantage. One case that came to my knowledge was a long belt that drove machinery in another building and around a corner. Some thirty horse-power was consumed in driving the other department. A separate motor was installed for a trial. A ten horse-power motor did the work and consumed only about six horse-power doing it. The trial became a permanent fixture.

How far to carry the idea is hard to determine. The first cost may be heavy, and yet such savings result that this cost is wiped out in a year. Convenience in a shop, rather than the cost of the motor or the power to run it, is most often the determining factor. Assuming that by introducing electric motors generally throughout a shop, the cost of all things considered were the same, it is quite possible to imagine such conditions that increased convenience would save 50% of the cost of the product. First cost and power might be disregarded under these conditions. Every case should be carefully considered by one familiar with all the conditions. If in doubt, a few motors should be tried, but nothing under five horse-power units should be used except in rare cases. The smaller units are expensive and not efficient, and machines should be grouped to get the five horse-power. Below two horse-power the electric motor is not efficient.

Competent and careful investigators have repeatedly found the losses of transmission due to driving or transmission devices to vary from 5 per cent. to 90 per cent. of the total power consumed. Here, then, in these days of small margins and close competition is the chance to save an annuity that will amount to a fair profit in most cases. The question of using copper or aluminum for transmission purposes is one worthy of consideration. In the case of a 9 mile transmission plant in my state, aluminum has been used. At the time of installation copper was selling at 17 cents per pound, and aluminum at 41 cents, yet the reduced weight of the latter made it the cheaper of the two. The average loss of transmission for the cotton mill and flax mill is 60 per cent., and for the woollen mill 40 per cent. In heavy iron working plants the loss is about 15 per cent. In any small mill or workshop the matter of friction is of the greatest importance, and, if I am not greatly mistaken, it is in the small mill that one generally finds the greatest neglect in such matters. In the large organizations such things are in the hands of some particular person, whereas in the small mill it is no one's business, and is neglected. Friction in mills is subject to great variations. Probably half the friction in the small mill is caused by lubricated surfaces. A change in temperature with improper lubricants, such as heavy animal oils, may increase or diminish friction to a considerable extent. Prof. Thurston estimates the friction of shafting in general, including the total belts and bearings, and varying with the size and load, at from 33 horse power to 1.5 horse-power per 100 feet. Prof. Benjamin, by careful investigation in many shops and with every precaution for practical and at the same time accurate results, found that in six machine shops, where heavy machine work was done, an average of 62.3 per cent. of the power produced was used in driving the shafting alone. In one case it was 80 per cent. This was explained by the fact that the shafting had to be built large enough for tools that are often idle, and necessarily the shafting must be kept running. In this item the tension of belts is a serious matter. A belt should be just tight enough to do its maximum work. Many belts, if not most of them, are much tighter than is necessary. No easy means is at hand to ascertain how tight a belt may be, and the belt mechanic sets it firm and tight to make sure that it shall not slip. Then when a wet day comes, a shop full of moderately tight belts makes a heavy drain on the coal pile. In this same investigation it was determined that the busiest of tools was only in operation 80 per cent. of the time, and the average tool about 33 per cent. of the time.

The argument has been made by those opposed constitutionally to nice work toward economy of any kind that the power amounts to little or nothing in the cost of a product. As a matter of fact the cost in percentage is small in machine shops, being from 1½% to 2%. This seems small indeed when stated this way ; but looked at as an annuity it takes on another aspect. Supposing for example the product costs a million per year, one per cent. means ten thousand dollars.

Another class of losses occurs in the bearings of the machines themselves. It has been found by test with motors, for the driving power, that printing presses, and other heavy machine tools, consume twice the power running idle that they should. Investigation disclosed the fact that the loss was in the bearings, and that they were very tightly adjusted. There is no means of telling how tight a bearing is when it is one of many in a train ; and had the machines in the cases mentioned been belt driven from a shaft, the friction would have continued until heating occurred or until the bearings wore loose. Again, to offset the argument that power saving is in any case only a small factor, we must consider that where there is friction there is wear, and that cost of repairs is increased by friction. This is a serious matter in the case of line shafting and counters. It means a mechanic at the works many Sundays in the year, to overhaul bearings and loose pulleys. The following general principles have been laid down by Prof. Benjamin to save friction losses in manufacturing establishments. There are none better and I quote :

1. Use pulleys of large diameter on counter shafts and narrow fast running belts.
2. Use the best oil for the purpose, and enough of it, catching the drip and purifying it for repeated use.
3. Have everything oiled regularly, and do not depend too much on even the best of oiling devices.
4. Inspect line shafts to see if in line and will turn easily.

Neglected shafting, both in respect to alignment and lubrication, is the cause of tremendous friction. Anything that will do away with both of these evils at once deserves earnest consideration. A good so-called "frictionless" bearing will do this, as lubrication is practically unnecessary, and heavy pressures produced by lack of alignment count but little. More of this later. Samuel Webber sub-divides the friction in a mill as follows : To run loose pulleys and their belts, 10 per cent. ; to run main shafting, 20 per cent.;—the engine itself takes but 6 per cent. He puts overtight belting and consequent bending of shafting with resulting heavy journal friction as the chief cause of transmission losses. I think the average manager does not look at it in this light. Even this source of friction may be avoided. If managers of factories would only take the pains to measure their idle load once in a while, they would find the information gained both instructive and surprising. Comparatively few do it.

Some noon hour, or some evening at six o'clock, turn off all work on all machines and see what your engine indicates ; it is something any of your engineers can do if furnished with an indicator, and I am sure you will feel repaid. Nine times out of ten you will overhaul a considerable number of things.

Is it not true that in almost any shop, if the bearing does not get heated, if it does not make a noise, if it does not stop the mill and nobody kicks, that there is not much thought about it?

My experience in such matters has been that some shafts may be turned by hand, and in other cases of similar dimensions a bar stuck through a pulley may be used for a lever in order to move at all. Subsequent test in these cases showed corresponding losses. In one or two instances I have seen loose pulleys driving shafting and waiting for Sunday repairs.

As a matter of general interest I thought I would look up the origin of belts. After doing so I made up my mind that it was prehistoric. The first belt on record seems to be in connection with the fire machine, the original method of starting a fire by friction. A ligament or other string was wound about a pointed stick and pulled as in spinning a top. Then followed the use of the belt in all the various ways known to us. It is old, but it is good, and I doubt very much if we shall ever drop it entirely, notwithstanding electrical motors. The rope is newer as a commercial feature. It serves its purpose admirably and is an efficient driver. Careful experiment has shown that when well arranged in each case, the efficiency of belt and rope is practically the same. The rope has one practical advantage and that is, that the tension may be exactly controlled by tension pulley and weight. On the other hand, the rope is not good for small powers. The necessary splicing and complication of manipulation count against it and practically bar the use of any size smaller than ¾ of an inch. A rope running over too small a pulley goes to pieces very fast, and the rope drive has suffered on account of this mistake in installing.

The following figures give an idea of the proper relative size of rope and pully :

For a 1¼ inch rope, diameter of pulley must be at least 3 feet.
For a 1½ inch rope, diameter of pulley must be at least 4 feet.
For a 1¾ inch rope, diameter of pulley must be at least 5 feet.
For a 2 inch rope diameter of pulley must be at least 6 feet.

These pulleys and ropes will transmit respectively per 100 revolutions per minute, 5, 8, 11, 15 horse power.

An increase of 25 per cent. over these figures is possible when the bottom rope is the driver and under proper conditions. The best speed is about 3,300 feet per minute. Cotton and manilla are equally good providing long fibre cotton is obtained, and, in any case, the character of the splice is all important.

The comparative efficiency of belt and rope, as determined at Lisle, France, by official investigation, is as follows : Power transmitted, 162 horse-power ; taking efficiency of rope at 100 (manilla) cotton is 100.87 and leather belt 100.37. To all practical purposes this difference is nothing.

As I have already emphasized, belt tension is most important. It is estimated that the pull of a belt is, as a rule, at least three times that necessary to transmit the power required. The velocity of belts should be kept at the maximum possible point, and the most efficient velocity is given at 4,000 to 5,000 feet per minute. Data on belts is to be found anywhere, and I will say but little, as there are branches of my subject on which there has been absolutely nothing written or published.

Mr. Souther spoke at considerable length on the subject of bearings and lubricants, advocating the greater use of the ball bearing and mineral oils.

THE DEVELOPMENT OF ELECTRICAL SCIENCE.

Major Henry A. Gray, president-elect of the Engineers' Club of Toronto, delivered his inaugural address at a meeting of the society on February 4th. After reviewing tersely the progress that has been made in harnessing the great natural forces of the earth, and the extension of railways, he traced the development of telegraphy, telephony and electric lighting, and quoted figures of very great interest. This portion of his address is given in greater part below:

TELEGRAPHY.

In the year 1837 Cooke & Wheatstone showed how electricity could be practically used in the intercommunication of ideas between different parts of the country. There was a line built in July of that year, connecting two small towns in England. A portion of this line was recovered during the year of the Queen's Diamond Jubilee, and used in the transmission of her simple, and at the same time, expressive message, as she started on her memorial procession through London, "From my heart I thank my beloved people. May God bless them." This was sent to every quarter of the Globe, being flashed over every continent, under every ocean and sea, and among the many replies from British colonies and elsewhere, the first to be received at the palace was from Ottawa, Canada, just 16 minutes after the message had been despatched. The line to which I have just referred was 1⅓ miles in length; during the 65 years since this pioneer line was inaugurated, the system of telegraphy has grown to embrace, I may say, the entire world, thus almost annihilating distance, and practically overcoming time.

The Late C. W. Lundy, Telegrapher, Halifax, N.S., who received the first message by Atlantic cable. Deceased December, 1901.

The extent of telegraph lines controlled by Britain and her colonies in the year 1895 was 1,111,366 miles; of this, 183,400 miles was submarine cable. England has always been in advance of other countries in the development of telegraphic service, which is chiefly due to inventions of members of our profession, viz., Latimer Clarke, his brother Edwin Clarke, and Cromwell Varley, all members of the Institution of Civil Engineers. The working capacity has been greatly increased, and messages can now be sent with a rapidity so great that they cannot be received by the clerical staff. The submarine cable still retains very nearly its original form, and the nature of the materials used in its construction have varied but little since the first cable was laid in 1851. The little crustacean which was found to be able to penetrate the gutta percha covering and thus expose the copper conductor to sea-water, which meant certain destruction, has been prevented by the use of a serving of brass tape, this having proved very effective. To the great inventive genius of Lord Kelvin, the perfection of the submarine cable is chiefly due. His recording apparatus is the one almost universally used to-day in cables of great length.

To attempt to predict, at this moment, what the future of telegraphy will be would indeed be folly. New instruments and new processes are constantly being introduced, some of which are adopted, others are found to in no way improve the present practice, or meet existing needs. The writing telegraph, invented by the late E. A. Cowper, which produces actual handwriting, and is called the "Telantograph," is being made practical use of, and electrical typewriting machines are by degrees replacing the A. B. C. visual indicator.

It is by no means, in my opinion, visionary to say that in a very short time wires in telegraphy will be entirely dispensed with, and messages of length and importance flashed through the air by means of Marconi's wireless telegraphy.

TELEPHONY.

The introduction of the telephone has to a great extent revolutionized the business methods of the day. The development of telephony has been so rapid as to seem almost incredible, and yet we know that the human voice is transmitted along wires for great distances by electricity every hour in the day.

It was in the year 1877 that two eminent engineers were sent from England to the United States to inquire into the accuracy of the report that a young Scotchman, by the name of Bell, had succeeded in accomplishing the astounding feat of making it possible for conversation to be carried between two or more persons separated by many miles, and it was in that year that the first pair of practical instruments were brought into England from the States by Sir Henry Fischer and his colleague, Mr. Freece.

The transmitting portion—that part which transforms the energy of the human voice into electric currents—has constantly been improved since Edison and Hughes demonstrated the use of carbon in a loose condition, subject to the change of pressure and of motion under the influence of sonorous vibrations. Speech is now possible between any two cities in the Dominion of Canada, and many of the principal cities in the United States. Telephony has become a part and parcel of the business institutions of the country, similar to the post and telegraph.

Concerning the Bell Telephone Company, in the year 1880 it had 13 exchanges, and a total of 2,100 subscribers. In 1900 it had 350 exchanges, 494 agencies and about 39,000 subscribers. It also had in 1900 some 22,000 miles of long distance lines.

The figures in the United States are approximately 47,880 subscribers in 1880, and 800,000 subscribers in 1900, with over 600,000 miles of long distance lines.

In 1899 the German Empire had 229,391 stations; Great Britain, 171,660; Sweden, 73,500; France, 59,927; Switzerland, 38,864; Austria, 32,255; Russia, 31,376, and Norway, 29,446.

ELECTRIC LIGHTING.

Just about 58 years ago Morse and Vail first gave a public exhibition of the electric telegraph, the earliest and for many years the only important application of electricity to the useful arts. It is difficult to realize that only a few years has elapsed since the first illumination of the streets of Paris by the electric candle, during the Exposition of 1878, gave renewed impulse to the study of electricity, which has resulted in the development of a long series of inventions already destined to make this subtle form of energy one of the controlling factors of modern civilization. In a work recently published on the economic value of electric light and power, the following interesting statement occurs, the truth of which will, I am sure, be recognized by every one here. So much has been done in applying electricity to the uses of light and power, that the following statement of some of the possibilities is no longer prophetic.

Electric light and power will produce more changes in the mechanical servants and conveniences of civilized life than has ever been caused by the use of any other method or force which has been subjected to the service of man. The uses of electricity are limited only by the want of intelligence in producing fitting apparatus for its application. The demand for such apparatus is limited only by the want of intelligence on the part of the public to know how to use it properly. So rapid has been the development of the electric industry, few have been able to keep trace of its achievements, and fewer still have sounded its possibilities for the purpose of giving direction to its growth.

It is now practicable to distribute from one central station all the light and mechanical power used in any city. Not only this, the light and power can be delivered to any point in the city, and more important still, it can be divided and delivered in any quantity needed. From the same central station, the same generator in the station, if need be, accompanying each other over the same conductor, as it were one spirit with two forms of expression, the electric current places at the command of the poorest member of society two basic requirements of civilized life, viz., light and power. They come without noise, heat, smoke dust or dirt of any kind. They consume no oxygen from the air; they bring no poisonous gases into the rooms; they destroy no property; they make life more healthful, comfortable, and freer from liability to accident; they are brought into use without any effort whatever; with silent, patient energy they wait the will of their employer.

But turn a key, and light appears where the sun cannot shine. But turn a key, and the tireless energy of the universe will play alike with the smallest toy, or the heaviest machine. Comply with its conditions, and the servant of all life will be present in light and power.

In June, 1877, William Edward Sawyer, a native of New Hampshire, who had been for some years a telegraph operator in the New England States, directed his attention to the making of inventions in electric engineering and electric lighting. The first direct satisfactory results of his labors in this direction was the improvement in electrical engineering and lighting apparatus and systems for supplying streets, blocks or buildings of a town or city, in a practiceable manner, with any desired quantity of electricity for the purposes of electrical illumination, electric heating, and running electro magnetic engines, etc. Generators of electricity were to be placed in convenient localities, and conductors carried over or under the ground along the streets, and to buildings in which the electrical current is to be utilized. The advantages of his invention are that it enables householders to obtain a supply of electricity for any purpose without care or inconvenience, and at a reasonable cost to consumers, and also renders practicable the lighting of buildings by electricity.

In the same year Sawyer patented a lamp, which although crude and impracticable to some extent, showed the line of investigation and development which he was pursuing. Unfortunately, Mr. Sawyer was, as is frequently the case with inventors, a man of limited means, which seriously retarded his work of perfecting his incandescent lamp, and it was not until he fell in with a lawyer by the name of Man, who was a scientist and had always taken a deep interest in the study of electricity, and being a wealthy man, he at once placed a sum of money at the disposal of Mr. Sawyer, which enabled him to continue the inventions, uninterrupted, until he had fully developed his original conception of a general system for the electrical distribution of light and power from a central station.

It was at this time, according to the earliest records, that the name of Thomas A. Edison was used in connection with electric lighting. In September, 1878, Mr. Edison went to work with a vengeance on the scheme of electric lighting, and in a very short time made the startling announcement that he could produce any number of lights up to 10,000 from the one machine, or for that matter the number he said may be infinite. But the actual results attained by Edison at the close of the year 1878 must be conceded to have accomplished nothing more than the old idea of an incandescent wire of platinum, a useless thermal regulator designed to be attached to each individual lamp, and the absurd tuning fork dynamo. He was on the wrong track, and had been from the very beginning. The triumphs of the future, as we now know, were destined to be accomplished by incandescent carbon, not by incandescent platinum, and by regulating the current at the source of the supply, and not at the individual burners. In both these points Sawyer was far in advance of Edison, for he had clearly shown by the patents that had been issued to him, and the intelligent conception of the nature of the problem upon which he was at work, an equally clear view of the true path to be followed in the development of the incandescent electric lamp. This was fully proven by the controversy which took place at the close of 1878 between Sawyer and Edison.

The further development of the hydro-carbon treatment was taken up at an early date by Hiram S. Maxim, under the auspices of the United States Electric Lighting Company, the first commercial incandescent lighting plant being installed in 1880 in the reading rooms of the Safe Deposit Company, 120 Broadway, New York City. This plant consisted of about 50 lamps, the illuminants of which had been subjected to the hydro-carbon treatment. In this lamp it was generally conceded that something like perfection had been reached, and Professors Morton and Draper testified to the value of the invention of Mr. Maxim, stating in their evidence that even Edison's dreams had been surpassed in the Maxim lamp. It is this style of lamp that is in use to-day.

The growth of electrical enterprises in United States and Canada is without doubt unparalleled in the history of the world in industrial development. Looking at it from a commercial point of view, incandescent lighting dates no further back than 1880.

I have obtained a few statistics showing the number of companies doing business in electricity in Canada in connection with lighting, which has increased from 259 in 1898, to 306 in 1901. The arc lights in use have increased from 10,389 to 12,800, and the incandescent lamps from 464,615 to 815,676. Estimating each arc lamp equal to ten incandescent, the use of electricity as a light has developed from 565,505 in 1898 to 943,656 in 1901. During these years, electricity for lighting purposes has increased over 60 per cent., or by some 276,171 lamps.

Of the number of lamps in use Ontario has 6,830 arcs and 384,496 incandescents, or about 48 per cent. of the total for the Dominion. In the city of Toronto there are 1,450 arc lamps and 80,000 incandescents, which equals a total of 94,500 incandescents. Ottawa has 585 arcs and 80,000 incandescents, or a total of 85,850, counting each arc as equal to 10 incandescents. Hamilton has 560 arcs and 21,265 incandescents, or a total of 26,895. London has 350 arcs and 17,180 incandescents, or a total of 20,680. Peterboro has 120 arcs and 7,000 incandescents, or a total of 8,200.

Quebec Province has not progressed so rapidly in the electrical line, and the number of arc lamps is 41,118 and the incandescents 270,120, or reduced to the standard of 1 arc equalling 10 incandescents, a total of 311,300. Montreal has out of this number 2,648 arcs and 108,210 incandescents, or a total equal to 134,690 incandescents. Altogether in the Province of Quebec there are 42 cities, towns and villages having electric plant companies, 22 of them are in the eastern townships.

Nova Scotia's total equipment is 465 arcs and 49,041 incandescents, distributed among 20 towns and controlled by 21 companies.

New Brunswick's total is 691 arcs and 18,131 incandescents, distributed among 10 cities and towns and owned by 11 companies.

Manitoba has only six towns provided with electric lights.

The North-West Territories have 5 electric light equipments.

British Columbia has 14 plants, furnishing 643 arc and 68,763 incandescent lamps; Vancouver city has of these 411 arcs and 29,424 incandescents.

The foregoing make a grand total for the places mentioned of 12,892 arcs and 825.201 incandescents, and reducing all to the standard of 1 arc as being equal to 10 incandescents, makes 954,121 lights in the year 1901. Contrast this with the year 1877, when Messrs. Sawyer & Man were endeavoring to perfect their first incandescent lamp, and we can then, to some extent, realize the development that has been made.

Of the total increase of 276,191 in 1901 compared with 1898 Ontario is credited with 152,755, Quebec 154,009, Nova Scotia 10,049, New Brunswick 7,431, Prince Edward Island 4,765. Manitoba is credited with 4,058, Northwest Territories 1,255, British Columbia 41,757.

MONTREAL.

(Correspondence of the CANADIAN ELECTRICAL NEWS.)

The Royal Electric Company deserve the highest praise for the way they hustled around after their rather serious fire lately. They had all arc circuits and private alternating circuits running the same evening. It is open to doubt if any other company in the Dominion could have done as well under similar circumstances. Every man pitched in with a will the moment the firemen had left the building, working in the smoke of coke fire pots (as used by plasterers for drying), which were immediately started to dry out the building. Luckily, the step-down transformers of Chambly transmission, which were in a wing, did not get damaged; and the small extra station at Sohmer Park was brought into play to take care of the street arcs. Even to-day the building is coated with ice where besprinkled by the fire department, and the old window frames temporarily sheeted with cotton show that the fight with fire was a good one. The new step-down and distributing station now under construction will be absolutely fire-proof and is being rapidly completed.

On the evening of the 20th January Prof. Rutherford gave an open lecture at McGill on the Marconi system of wireless telegraphy. It was a treat to all those that were able to get in, and "standing room only" was the order long before the lecture commenced. Prof. Rutherford advanced a theory of his own for the Hertzian wave following the rotundity of the earth's surface which is perhaps the most acceptable and certainly the most lucid yet promulgated, viz:—As the electric spark passes more quickly in vacuo than in the ordinary atmosphere, and as the higher strata of air is owing to its rarity a nearer approach to vacuum than the lower, Prof. Rutherford deduces that the wave leaving as it does at right angles, by travelling quicker above, retains that position until the receiving conductor is reached.

The third of a series of lectures before the Grand Trunk Railway Literary and Scientific Institute was delivered by Mr. W. B. Shaw, of the Montreal Electric Company, on January 21st. The subject was "General Information on Electrical Subjects of Use to Engineers and Machinists."

MARCONI VANQUISHES THE TRANSOCEANIC CABLES.
From the New York World.

AN IMPORTANT LEGAL DECISION.

The Corporation of the Town of Rat Portage vs. The Citizens Telephone and Electric Company of Rat Portage.—Trial at Rat Portage on the 21st December, 1901, before Britton, J., without a jury.—On January 16th, 1902, Judge Britton delivered the following judgment :—This action is brought by the plaintiffs to have a contract on agreement, dated the eleventh of September, 1899, declared invalid on the grounds (1) that no by-laws was past authorizing or sanctioning it, (2) that the agreement was not executed by any duly authorized agent of the plaintiffs, and (3) that the agreement was not drawn, signed or sealed in a way to bind the plaintiffs.

Prior to 1895 the plaintiffs had made a contract with a company for lighting the streets of the town of Rat Portage. Defendants acquired the right of that company and with the consent of the plaintiffs, performed that contract until its expiry, and afterwards continued to furnish street lighting for the town. On the first day of February, 1895, a new agreement was entered into (Ex. II) by which the defendant company was to install electric plant, and do the street lighting of Rat Portage for five years from the first of February, 1895 on the terms stated in that agreement, which agreement was made with all the forms necessary to be binding upon the plaintiffs, and the terms of it are not very different from the agreement now in question. This agreement was for five years and was therefore good until the 1st of February, 1900. Having regard to the near approach of the time for expiry of this agreement, negotiations were on foot between the parties for a renewal—or for a new contract. On the 14th August, 1899, a resolution was passed by plaintiffs' council declaring all negotiations with defendants off, and instructing the clerk to call for tenders for a five years service for street lighting and fire alarm (Ex. 4). Tenders were advertised for, to be put in on or before the 7th September, 1899. Defendants' company tendered and in accordance with advertisement handed in with the tender a marked cheque for $1000. This tender was in the terms of a draft contract alleged by the defendants to have been agreed upon before them by a committee of plaintiffs' council.

The council met on the 11th September, 1899. The whole matter of street lighting, fire alarm and telephone service was discussed. Mr. McCrossan, the defendants' manager, was present ; the tender and draft contract were produced, the defendants' manager was asked in consideration of a new contract being entered into, to relinquish any claims or charges for fire alarm maintenance accruing since November, 1898, and this the defendants' manager agreed to then and there, writing a letter to the Mayor and council to that effect (Ex. 7), whereupon the following resolution was adopted :

"That the tender of the Citizens' Telephone and Electric Company for street lighting, fire alarm, and telephone service, now under consideration, be accepted by this council, and the Mayor and clerk be authorized to sign the contract prepared, and the date of commencing under said contract be on or before the 30th day of September, 1899. This will enable the citizens to receive the benefit of the arc lighting in every advantage, as set forth in the said contract."

The mayor was not present at that meeting. The contract, which had before then been prepared, was at that meeting signed by C. W. Beylea, the acting mayor, and by the clerk, and the corporate seal of the plaintiffs' corporation was affixed.

On the following day, the 12th of September, 1899, the defendants got a return for the marked cheque for $1,000, which had been deposited with the tender. Shortly after the meeting of the 11th of September, it was rumored that the contract was invalid, because the mayor had not signed it. On the 13th of November, 1899, at a meeting of the council, a resolution was adopted, (Ex. 9) reciting the agreement of the 11th of September, the signing of it by the acting mayor, that the agreement had been questioned, &c., and then as follows : "Be it therefore resolved that this council doth hereby ratify and confirm the action of the said C. W. Belyea in signing the said agreement on behalf of the corporation of the town of Rat Portage, and also the said agreement, and it is further resolved that all other acts heretofore or hereafter to be done by the said C. W. Belyea in his capacity as acting mayor, and within the scope of his authority as acting mayor, are hereby allowed and confirmed."

On the 27th of November, 1899, at the meeting of the plaintiffs' council, the minutes of the meeting of 13th of November were read and confirmed, and signed, and the corporate seal was affixed at the foot of these minutes.

From that time until the commencement of this action the contract has been treated as a valid and binding contract, and has been satisfactorily performed by the defendants and paid for by the plaintiffs.

The whole story of the negotiations which led up to the making of the contract, is told in the statement of defence, and is in substance as now stated.

There are few, if any, facts in controversy between the parties. And upon the evidence, I find the facts as stated by me.

The plaintiffs contention is that no by-law was ever passed sanctioning the transaction, and by reason thereof the agreement is nugatory and invalid.

The contract was fairly entered into after a good deal of careful consideration, and the plaintiffs seem to have made a good bargain, safely one would think guarding the interests of the citizens. If there is any necessity for a by-law in this case the plaintiffs' council should have passed one, and if the plaintiffs can take advantage of their own neglect and repudiate their own agreement after two years' performance, it will be unfortunate.

The contract in question, even without express enactment, would seem to be within the powers of the council, for the business and safety and comfort of the citizens of a town of the size and importance of Rat Portage require street lighting, which the council should provide, but sec. 568 of the Municipal Act covers this point by enacting that

"Every municipal council shall have power to contract for a supply of gas or electric light for street lighting and other public uses, for any number of years not in the first instance exceeding 10, and for renewing such contract from time to time for such period not exceeding ten years, as the council may desire."

The whole question of the necessity of a by-law to create a liability on the part of a municipal corporation on an executory contract was discussed and decided in the case of the Waterous Engine Works Company vs. Palmerston 21 S.C.R. 556.

The sections 282 and 480 of the Municipal Act then in force were considered. Section 282 is the same as section 325 of present act, and section 480 for purpose of comparison and argument the same as section 565 of present act. In that case, in the absence of a by-law authorizing the purchase of a fire engine, and the contract not having been completed by the acceptance of the engine, the town was held not to be liable.

Apart from the neat question of the necessity of a formal by-law, what was done in this case is important on the questions of "executed contract" and estopped and acquiescence.

Section 568 authorizes the council to contract, and the council, in open meeting, acting as a contracting party, considered and decided upon the matter and authorized the signing of a formal contract by the acting head of the council and by the clerk, and authorized the affixing of the corporate seal. This is something done by the Legislative authority and was as well considered as a by-law. In substance it complies with all that is requisite. The form of by-law only is wanting.

There was no need of the resolution of the 13th of November, 1899, because the acting mayor has all the powers of the mayor, see Section 272. Section 10 provides that the powers of the body corporate shall be exercised by the council. Bernardin v. Dufferin 19 S. C. R. 581 is authority for the proposition that a corporation is liable on an executed contract for the performance of work within its powers, which work it has adopted, and of which it has received the benefit, though the contract was not executed under corporate seal. Upon the facts above stated the absence of a formal by-law is no more than the absence of a seal.

I think this is to all intents and purposes an executed contract —not completely because it has years to run, but the defendant had given up something of value and the plaintiffs have received the benefit of it.

A valid contract in full force on 11th September, 1899, was terminated by defendant ; claims which the defendant had against plaintiffs, including one of $50 a month from 1st December, 1898, to 11th September, 1899, were abandoned.

If cancelled now, plaintiffs get all the benefits bargained for after two years' service, which the defendant company agreed to give only by getting a five years' contract, renewable for another five years. Then the defendant company has by reason of plaintiff's agreement changed its plans, purchased a large amount of plant and expended money on improvements adequate compensation for which cannot be made by the payment which the plaintiffs are willing to make.

I am also of opinion that the plaintiffs are bound by their acquiescence and they are estopped from successfully maintaining an action.

The Corporation of Pembroke v. Canada Central Railway 3 O. R. 503 decides that a Corporation may be bound by acquiescence as an individual may. This is not a case of any rate-payer objecting. It is an action by the corporation which made the agreement. The council is not, so far as appears, asked by any citizen to take this action. The council—the acting body of the corporation—the council which made the contract, could if they thought proper have passed a by-law authorizing or ratifying the contract. Their not doing so looks like bad faith on the part of plaintiffs.

After the action of the council on the 11th September, 1899, the plaintiffs approve and acquiesce in the contract as before stated by me—1st, on the 12th September, by giving up marked cheque, 2nd, on the 13th November by formal resolution approving of the agreement, and 3rd, on the 27th November when minutes of 13th November were read, confirmed and formally signed and sealed with plaintiffs' corporate seal. Again this contract was acquiesced in by allowing defendant to continue in its performance, and by plaintiffs' estimates for the years 1900 and 1901 and by by-law in each year for raising by taxation, in addition to other sums required, the special amount necessary to pay to the defendants under the agreement in question.

The plaintiffs' council could raise the money to pay upon this contract only by by-law authorizing the rate and the collection of it. On these estimates see sections 404, 405, of Municipal Act.

The by-law authorizing the levy each year, in effect, and in a way the council could lawfully act, ratified the agreement in question. See Robins vs. Brockton, 7 O. R. 48.

The action should be dismissed with costs. The defendants are entitled to a declaration that as between the parties the contract is a valid and binding one, and the plaintiffs should carry out the same in all respects.

NEW WIRE AND CABLE FACTORY.

The accompanying illustrations show the works of the Dominion Wire & Cable Company now in course of erection in the city of Montreal. The company expect to occupy their new building in April. The ground floor of the factory covers an area of 30,000 square feet, and the first and second floors have each an area of 6,400 square feet. There will be an additional building erected in the spring, which will contain the offices of the company and extra store rooms. This building will be situated on Guy street.

Factory of the Wire & Cable Company, Lusignan Street, Montreal.

When the new works are completed they will embrace departments for the manufacture of lead covered cables for telephone and power purposes, wire drawing and annealing departments, a rubber insulating department and a trolley wire plant. It is also the intention of the company to manufacture weatherproof wire and cables. The upper floors will be used entirely for the covering of fine wires and the manufacture of electro magnets.

The power plant is to consist of two B. & W. 300 horse power boilers and a Robb-Armstrong tandem compound engine, direct connected to a Western Electric Company generator. There will also be a Westinghouse generator set of 300 horse power. The electric elevator to be installed is being manufactured by the Otis Elevator Company, of New York.

NIAGARA POWER DEVELOPMENT.

Considerable progress has been made of late towards the development of power on the Canadian side of Niagara Falls. A fortnight ago the Canadian Niagara Power Company awarded the contract for the construction of the wheel-pit and intake canal of the Canadian works to Messrs. Dawson & Reilly, of St. Catharines. This contract amounts to over half a million dollars, bringing the total sum represented by contracts now awarded to one and three-quarter million dollars. The wheel-pit will be 175 feet long, running parallel to the river, with a width of 29 feet and a depth of 160 feet. The intake canal will be 600 feet wide where it comes in the river and 14 feet deep. The water from the river will be taken direct to the penstocks in the wheel-pit,

It is understood that contracts have just been placed with the General Electric Company for the construction of three 10,000 horse power generators for the new plant. These dynamos, it is asserted, will be the largest yet built. Vertical shafts over 100 feet long will connect the water wheels with the generators.

Mr. W. B. Rankine, vice-president of the Canadian Niagara Power Company, states that the company has received a number of inquiries for power on the Canadian Niagara frontier. The company is believed to be preparing to transmit power to Toronto and cities en route.

The Premier has introduced a bill in the Ontario Legislature to confirm an agreement between the commissioners of the Queen Victoria and Niagara Falls Park and the Canadian Niagara Power Company. The agreement, dated June 19, 1901, provides that the period for the completion of the work specified in the agreement of April 7, 1892, be extended to July 1, 1904, on condition that the company expend $500,000 on the work of development by July 1, 1902, and a further sum of $1,000,000 by July 1, 1903. The company shall also make default unless they develop 50,000 horse power by July 1, 1904, and have on that date an overflow tunnel sufficient for not less than 100,000 horse power and actually ready for use 20,000 horse power.

Mr. H. B. Andrews has resigned the management of Grimsby Park and will shortly leave Toronto to become superintendent of an electric railway in Tennessee.

The corporation of Glace Bay, N. S., have completed the installation of a municipal electric light plant. The power house is 72x40 feet, with a smoke stack 43 inches in diameter and 100 feet from the ground. The building is divided into two compartments, one being occupied by the boilers and the other by the dynamos. Of the latter there are two 72 k. w. 2,400 volts S. K. C. machines. The engines are of the Robb-Armstrong side-crank pattern, each 120 horse power. In the boiler room are two Mumford Standard boilers of 150 horse power each, placed on concrete foundation and set in brick. The plant furnishes current for 212 street lamps of 30 candle power and about 300 incandescent lamps in business places and residences. The electrical equipment was installed by Mr. W. H. Pickles, of the Canadian General Electric Company, and the power plant by Mr. C. D. McKay, of the Robb Engineering Company.

Factory of the Wire & Cable Company, Guy Street, Montreal.

INSPECTION AND OPERATION OF STEAM BOILERS.

Toronto, January 30th, 1902.

Editor Canadian Electrical News:

Dear Sir,—I noticed that at the last convention of the Canadian Association of Stationary Engineers the Legislative Committee was instructed to again try to secure the passing of an act to provide for the compulsory inspection of steam boilers and the examination and licensing of engineers in charge of steam plants in the province of Ontario. I consider this would be a move in the right direction, providing that the proposed law would be a workable and just one, and that it be enforced properly, and men appointed as inspectors who are practical engineers, and not selected on account of their political pull and heeling.

If we are to have a law here in Ontario, I trust it may not be such a farce as the law at present in force in the province of Quebec, as we would be far better off without it. I know for a fact that under this iniquitous farce men have received certificates as engineers who have never had charge of an engine in their lives, and I have it on good authority that one man went down from Ontario and was examined and received a certificate as a boiler inspector, and this same man had never had charge of a boiler and engine, or even held a position as fireman or served any time as a machinist in his life. But simply because his friends had a little pull he was awarded a certificate as a boiler inspector.

How would practical engineers (who have served many years in charge of steam plants) like to see a law in force in this province which would give authohity to men of no experience, like the above, to come round and inspect their boilers and pronounce an opinion as to whether or not they were keeping the boiler and machinery under their care in a proper condition and also for this same stamp of an inspector to have the power by law, of examining engineers for certificates of competency.

Unless the engineers of Ontario have some reasonable assurance that, in the event of their securing legislation, the positions of inspectors will be filled by practical and qualified engineers of good character, then I claim we had far better leave the legislation alone and go on as we have done for years passed, rather than be cursed with such an infamous law, which grinds out engineers without any experience as such, and boiler inspectors also occasionly, when sufficient pull is brought to bear in the right direction.

I may have more to say on this subject, Mr. Editor, in the future, as I am gathering information, and may be able to interest your readers more than at present.

Yours truly,
"Practice."

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of. Hours
	H.M.	H.M.	H.M.
1....	P.M. 6.20	P.M. 2.30	8.10
2 ...	" 6.20	" 3.20	9.00
3....	" 6.20	" 4.00	9.40
4....	" 6.20	" 4.45	10.25
5....	" 6.20	" 5.30	11.10
6....	" 6.20	" 5.30	11.10
7....	" 6.20	" 5.30	11.10
8. ..	" 6.20	" 5.30	11.10
9....	" 6.20	" 5.30	11.10
10....	" 6.30	" 5.30	11.00
11....	" 6.30	" 5.30	11.00
12....	' 6.30	" 5.30	11.00
13....	" 6.30	" 5.30	11.00
14....	" 6.30	" 5.30	11.00
15....	" 11.00	" 5.30	6.30
17 ...	" 0.00	" 5.30	5.30
18....	" 1.00	" 5.30	4.30
19....	" 1.40	" 5.30	3.50
20....	" 2.15	" 5.30	3.15
21....	" 3.00	" 5.30	2.30
22....	" 3.30	" 5.30	2.00
23....	No Light.	No Light.	....
24....	"	"	...
25....	A.M. 6.40	A.M. 9.30	2.50
26....	" 6.40	" 10.30	3.50
27....	" 6.50	" 11.30	4.40
28....	" 6.50	" 0.20	5.30
29....	" 6.50	" 1.15	6.25
30....	" 6.50	" 2.00	7.10
31 .	" 6.50	" 2.45	7.55

Total 214.30

THE GEE ELECTRICAL ENGINEERING COMPANY.

The Gee Electrical Engineering Company, Limited, 11 Colborne street, Toronto, is a comparatively new concern which has made rapid advancement. Business was commenced twelve months ago in the name of Gee & Company, with offices in the Queen City Chambers, Church street. The volume of business steadily increased until it became necessary to augment the capital of the company. A charter was obtained for a capital stock of $10,000, and a change in the name to the Gee Electrical Engineering Company, Limited, the directors being G. A. Harper, president; W. Gee, managing director; and W. P. Hunter. New premises were obtained at 11 Colborne street, and manufacturing was started. Very shortly it was found necessary to have still more capital, and application was made and granted for an increase from $10,000 to $50,000.

The Gee Electrical Engineering Company are manufacturers of dynamos, motors and electrical appliances generally. They make a specialty of outside wiring for lighting, telephones, bells, etc., and manufacture direct current generators, motors, arc lamps, rheostats, switches and electrical accessories. An important branch of their business is the manufacture of the Gould storage battery. This battery, it is claimed, possesses many points of merit over other batteries on the market, and it is proposed to publish in the next issue of this journal some of the details of its construction, in which its advantages will be pointed out. The Gee Company believe that storage batteries will be very largely used in Canada for isolated plants, station work, etc. The company have secured a contract from the Gould Storage Battery Company, of New York, to build their train lighting equipments for this country. Thus, with the manufacture of the storage battery and the large business that is being done in dynamos, motors, supplies and wiring, there is every prospect of a promising future. The contracts now in hand include the wiring of Wm. Davies' new factory, Park, Blackwell & Company's factory, Harris abattoir, Grace Hospital, Leiderkranz building, York County Loan building, Ontario Wind Engine and Pump Company's building, complete lighting plant for George Rathbone, Toronto, apparatus for the Cannington Electric Company, complete overhauling of the plant at Port Colborne, Ont., and some twenty other contracts. The whole of the premises at No. 11 Colborne street is now occupied by the company, and arrangements are under way for further extension.

Mr. W. Gee.

Mr. W. Gee, the managing director of the company, possesses a thorough knowledge of the electrical business. For seven years he was engaged with Woodhouse & Rawson, London, England, and for five years with the Edison-Swan Company, of the same city.

The many friends of Mr. H. P. Dwight, President of the Great North-Western Telegraph Company, learned with regret a fortnight ago that he had accidentally broken his leg, and will in consequence be confined to his home for some weeks at least. It is learned, however, that he is making favorable progress, and conducting the correspondence and business of his office from his home. It is hoped that in a very short time he may be able to be about again as usual.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The Educational Committee of Toronto No. 1, C.A.S.E., some time ago secured the promise of Mr. Warren S. Johnson, Am. Soc. M.E., president of the Johnson Electric Service Company, of Milwaukee, Wis., that he would come to Toronto and deliver a lecture before the Association. Accordingly, arrangements were made for the lecture to be given in Engineer's Hall, 61 Victoria street, on Wednesday evening, February 5th, the subject being "Heat Control." A large number of engineers and interested persons were present to hear Mr. Johnson, who is perhaps the best authority on the subject in question on the American continent. There was much disappointment when it was announced by the president that Mr. Johnson had become snow-bound and was unable to reach Toronto in time to fill his engagement. An effort will be made to fix another date with Mr. Johnson. At the request of the president an informal talk was given by Mr. King, of the Toronto Engineers' Club, who had recently returned from Philadelphia and New York, whither he went to secure information on the question of steam heating.

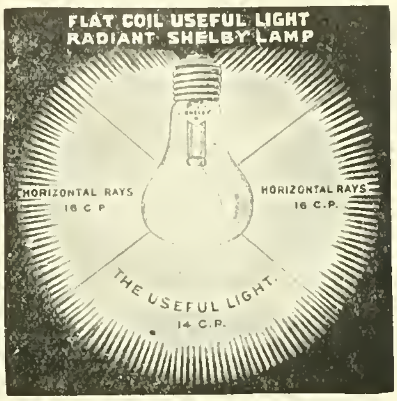
The annual At-Home of Toronto No. 1 will be held in St. George's Hall, Elm street, on February 24th.

SPARKS.

A Hamilton woman is seeking to have an electric light company restrained from destroying her peace with a noisy dynamo. She went to Hamilton for rest and quiet, and she is certainly entitled to it.—Toronto Star.

A dispute between the Dominion Coal Company and the Cape Breton Electric Company is attracting attention at Sydney, N.S. The workmen of the latter company laid several hundred yards of rails at different points where the proposed tramway will cross the old Reserve road-bed. Next day the rails were removed from the Reserve crossing by the Dominion Coal Company. It is said that the tramway people claim that as there are no rails on the Old Reserve road-bed they are within their rights in laying their rails across the old track. This the coal company deny, claiming that the electric company has no power to do so without legislative authority.

The Halifax Tramway Company carried out extensive improvements to their plant during 1901, and it is their intention to expend a considerable sum this year on the lighting department. The new city street lighting contract with the company takes effect on July 1st next, and is for five years. Under the new contract the company will give the city the very latest type of lamps. About 250 arc lamps will be required for the city streets, and the incandescent lighting capacity of the station will be increased about 9,000 lamps. A new generator, direct connected to a 1,500 horse-power engine, is about to be installed. It is also probable that the company will add another battery of boilers of 500 horse power. Mr. F. A. Huntress, manager of the company, is busy preparing for the installation of the new equipment, and expects to have one of the most complete stations in Canada.



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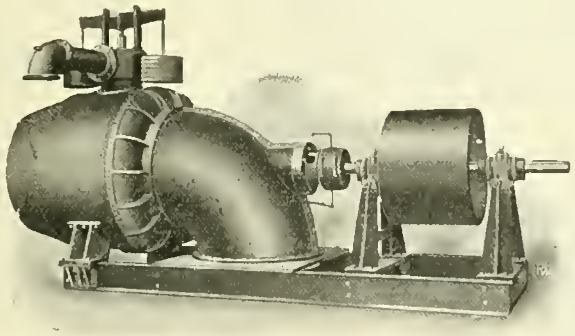

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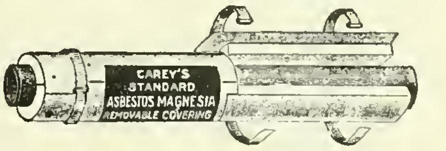

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SPARKS.

It is understood that the Dominion Government will place a sum in the estimates to assist Marconi in building his proposed wireless telegraphy station in Cape Breton.

The power house of the Niagara Falls Park & River Railway Company at Niagara Falls, Ont., suffered slightly by fire on January 17th. The fireproof nature of the building prevented much damage.

The Peterborough Radial Railway Company is asking for incorporation, to construct a railway through and connecting the villages of Peterborough, Ashburnham and Lakefield, and eventually extending to Rice Lake.

The annual meeting of the Montreal Telegraph Company was held in Montreal last month. It was decided that the board of directors should in future be composed of six members instead of eight, the places made vacant by the deaths of Mr. Andrew Allan and Mr Hector MacKenzie not being filled. Mr. Hugh A. Allan was re-elected president, and the board of directors was continued as before.

Dr. J. C. McLennan recently delivered an interesting lecture in the Physics Building of Toronto University on "Some Recent Advances in Electricity." He demonstrated the fact that a leakage of electricity takes place through gases, from that going on to deduce that gases are divided into minute particles, and arguing that the negative-charged particle must be smaller than the hydrogen atom, until very recently regarded as the smallest in existence.

Messrs. Murray & Gregory, of St. John, N. B., applied to the city council for a lease of the islands above the falls. They intimated to the council that it was their intention to develop the power electrically. Ald. Millidge pointed out that there would be difficulty in doing this owing to the intermittent tides, by which the force of the power would greatly vary. Mr. Gregory admitted that was a difficulty, but thought it could possibly be overcome by the use of the new Edison storage battery. He had written to Edison explaining the conditions and sending him photographs, etc., and he had replied that he was much interested in the idea and that he had no doubt his battery would prove adequate for the requirements.

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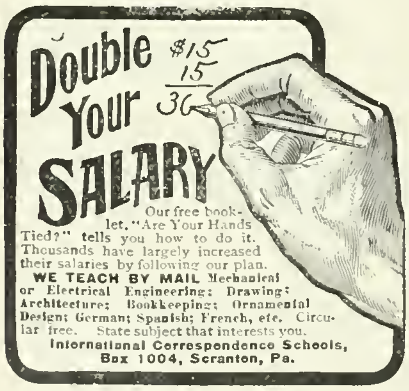

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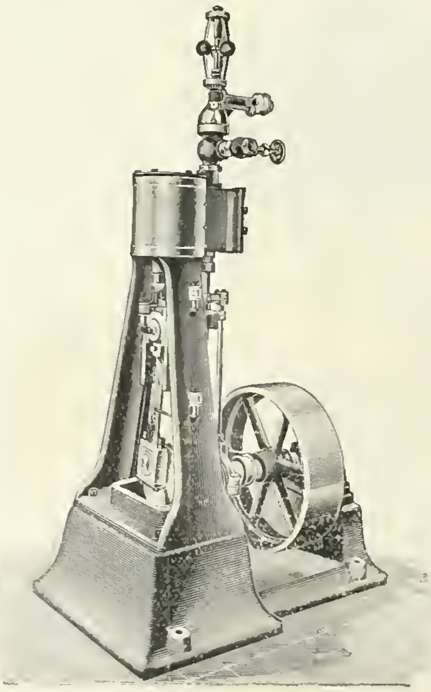


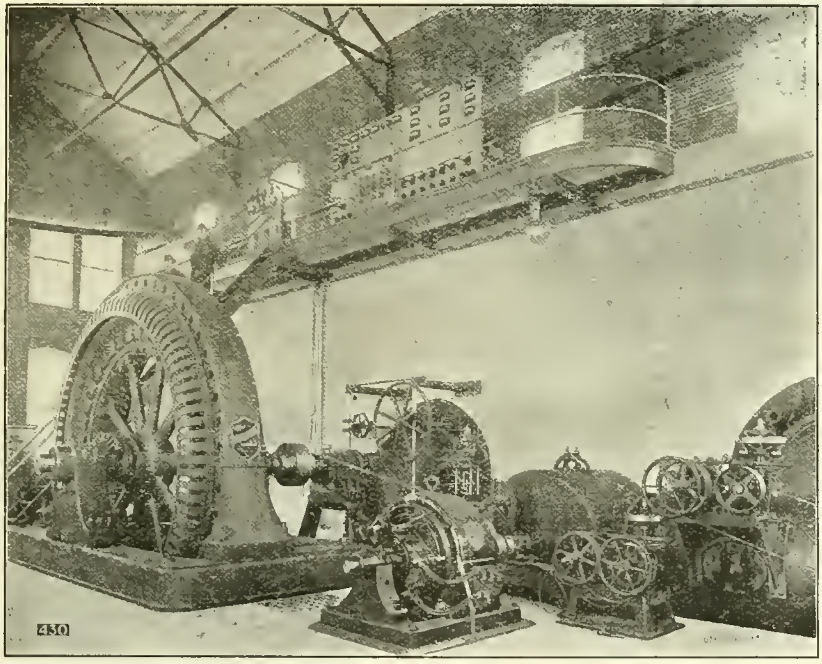
CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. XII. MARCH, 1902 No. 3.

SHEIK'S ISLAND POWER PLANT.

By F. H. LEONARD, JR., E. E.

On the 11th of January, 1902, a party of prominent engineers and managers of electric power plants, were the guests of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, on a trip to visit the power plant designed for Mr. M. P. Davis by Messrs. T. Pringle & Son, of Montreal. A special Pullman car took the party from Montreal and was met at Cornwall by Mr. Davis, who had brought with him from Ottawa in a special Pullman car, some of his friends and a number of Government officials. The whole party drove in open sleighs from Cornwall, along the canal bank, to the power house at Milleroches, a distance of about six miles, inspecting on the way the construction of the transmission line and arc lamps hung for lighting the canal banks and locks and the switch cabins and transformer houses placed at the various locks for controlling the electrically operated mechanism for opening and closing the gates and operating the weirs.



SHEIK'S ISLAND POWER PLANT—GENERATOR AND EXCITER.

The photograph representing the parties present, gives a glimpse of the interior of the power house, and another photograph shows one of the 1000 k. w. generators and exciters in place direct connected to the water wheel shafts. Three additional units similar to this are to be installed later. A view of the switchboard shows the general arrangement of machine and main exciter and feeder panels, as well as the arrangement of the arc switch-board and induction regulators.

The large rotating field generator has a capacity of 1,000 k. w., or about 1350 h. p., and runs at 180 r. p. m., having 40 poles, gives a frequency of 60 cycles per second, delivering current at the buss bars at a potential of 2,200 volts.

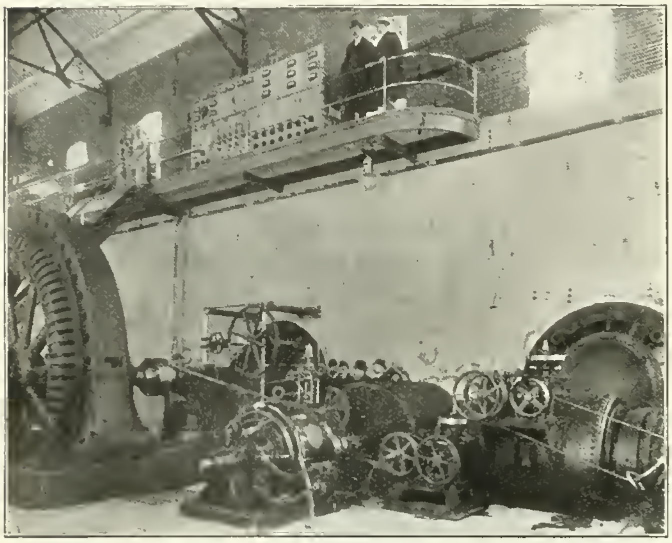
The exciters have a capacity of 50 k. w. and are sufficient to excite four generators similar to the one described above. Two exciters have already been installed, so that in case of accident to the exciter or wheels connected with it, the other unit can be immediately put into operation to take the place of one which might have been accidentally disabled.

At the switch-board connections are made with cables leading to the wire tower, on the second floor of which are located the raising transformers which increase the pressure from 2,200 volts to 11,000 volts for the power transmission circuits, and to 8,800 volts for use in connection with the 100 light circuits of series enclosed alternating arc lamps, 250 of which are at present distributed along the canal banks and at the locks, bridges and guard gates for lighting the Cornwall canal. The power circuits distribute current for operating canal gates, swinging the bridges and controlling the weirs at the various points from lock No. 15 to lock No. 21, a distance of about 11 miles, step-down transformers being provided at the locks to reduce the line pressure from 11,000 volts to 550 volts, at which it is used in the induction motors. This work does not utilize the full capacity of one generator, but it is proposed to shortly install additional generator capacity so as to provide power for other enterprises which are now operating by steam, or which may later be attracted to the spot by moderate price power delivered electrically in shape ready for utilization in various classes of industry.

The power house building is 40 feet by 90 feet, built of brick above the line of cut stone arches over the tail-race, and has a steel frame which supports a 25 ton travelling crane running the whole length of the building, and is covered by a steel trussed roof of heavy plank, the whole construction being practically fireproof.

On the side of the power house next to the head-race is located a steel framed tower, 13 feet by 15 feet, with brick walls three stories in height, the lower story of which is occupied by the high potential switchboard, the next story with step-up transformers, and the top story is devoted to lightning arresters and distributing the ends of the cables onto arms which support the transmission lines so that they leave the tower from the two opposite sides to serve lines running in opposite directions from the power house.

The main floor of the power house is occupied by the generators, exciters and governors for the water wheels, the bulkhead extending about 8 feet into the power house, the top of which at an elevation of about 19 feet above the main floor, serves as a switchboard gallery, the width being increased about 4 feet by brackets, over which the floor is extended, communication between the gallery and main floor being obtained by means of an iron staircase at the centre with brass railing, which also extends around the gallery to both ends of the power house where there are iron ladders on the face of the bulkhead, giving additional means of communication from the generating floor to the switchboard gallery.



Sheik's Island Power Plant.—Switchboard Gallery.

The switchboard is of the Wagner type, with illuminated dial dead beat instruments for indicating the current in each phase on the generator panel, a voltmeter switch being provided so the single volt-meter indicates the voltage on any phase. Totalling wattmeters are also located on the generator panels, as well as static ground detector, synchronizing lamps and main switch of the oil type and double brake knife switch for generator fields. A double-throw switch provides for lighting the station either from the exciter circuits or from a transformer on the generator circuit.

The exciter panel has a D.C. voltmeter and ammeters for each exciter with double throw switch so either exciter can be used with any generator or both can be run together to excite all the generators.

The feeder panels have ammeters in each phase and oil switches for opening and closing the circuits, as well as expulsion fuse blocks in each phase. One panel feeds the Milleroches power and lighting circuit at 2,200 volts, another connects the 11,000 volt, step-up, air cooled transformers in the tower with the 2,200 V. bus-bars, while another connects the three 60 k.w., 8,800 V. arc lighting transformers to the bus bars, space being left for five additional feeder panels.

The arc switchboard and generators are located beyond the space left for additional generator panels at the left of the gallery, the circuits being controlled by plug switches which are also used for making up connections to the transformers. Hot wire ammeters are used to indicate the current in each circuit and a static ground detector provided with plugs for each circuit.

The arc regulators are finely finished with blue Vermont marble tops to match the switchboards and polished brass trimmings.

In the lower floor of the tower is located a high tension plug switchboard with enclosed fuses for making up circuits on the 11,000 v. power lines and for connecting primaries of transformers to cables ; but these switches will seldom, if ever, be used for opening circuits as the oil switches on the main switchboard will serve to open the circuit on the low tension side at the bus bars. It is expected later to install dummy panels in the main switchboard to operate electrically controlled automatic overload switches built in brick compartments in the tower.

The lead covered cables connecting the dynamos and exciters with the switchboard are hung in brackets located in trenches left in the concrete and ascend on the face of the bulkhead, where they are distributed from a central point in either direction through a trench back of the switchboard, which is covered with hardwood gratings oiled and shellaced. The cables are also supported in brackets and stanchions in regular order in this trench, which also conducts the cables from the switchboard into the space below the ground floor of the wire tower, up the sides of which the cables are supported on insulating brackets until they reach the top floor where the three wires in each cable are separated at the cable heads and connected to the outside lines on the arms inside near the ceiling of the top floor. Iron brackets outside of the tower near the top support two timbers, one above the other, into which the insulator pins are inserted, below which a platform outside the upper windows is located at a convenient height, making the wires accessible for connections, etc.

The Party who Visited the Sheik's Island Power Plant on January 11th, 1902.

The line construction is plain, and substantial shaved cedar poles are used with the exception of a few iron structures at the bridge piers and locks. All poles are exceptionally straight and stocky and are located 100 feet apart on the canal banks, each pole being located and lined by the Government engineers. All poles on curves are guyed with galvanized signal strand and where guy stubs are not used two globe strain insulators are used to insulate the guys anchored in the ground. All the poles are painted and lamp poles are are stepped and pipe brackets 2½ feet long support the lamps which are hung on Cutter porcelain insulating hangers, in addition to the loop and porcelain insulator on the lamp.

Six pin arms are used on the line with pins 16″ on centres and braced with steel braces. Double arms are used on all sharp turns bolted through the poles and at the ends. The upper cross-arm carries the two three phase 11,000 v. lines and the arm below carries the arc circuits except near the two ends of the line where one-half of the arm is used for three phase and the other for arc circuits. No. 6 (medium hard drawn) bare copper wire is used for both arc circuits and power feeders, supported on 4½″ triple petticoat glass insulators tied on top.

The total line drop is about 5 per cent., and in some cases less, but on account of mechanical strength it was not deemed advisable to reduce the size of the copper. A line of barbed wire is stretched the whole length of the line on insulators on the pole tops and grounded at every fourth pole as a protection from lightning, though lightning arresters are provided at the power house and at the cable crossings. The high potential lines cross the canal in paper insulated lead covered and armoured cables and provision is made for tying the lines together at various points so that in case of break down the lines can be connected so as to work around the point in trouble.

At each lock little sub-stations or cabins are located to contain the transformer fuse boards and switchboards for controlling the motors for operating the gates, etc. These cabins also serve to cover the joint in the cables, which passing through the floor go underground to the masonry walls of the locks, then through the course below the coping stone and down the spare stop log checks at the head of the lock, crossing on the bottom out of danger of injury, as they are below the level of the top of the breast wall and covered with a 10″ x 12″ timber, thence up the other side in the check in the masonry to the same level as the starting point, then through the wall and earth into another switch-board cabin on the island between the two locks. The motors on each side of the two locks and at the weirs being controlled from separate switch-boards, though the cabins between the two locks side by side, contain switches for motors operating one side of each lock.

The three-phase high potential is reduced in a bank of three Packard tranformers from 11,000 to 550 volts and only the lower voltage distributed about each group of locks except for series arc lighting which crosses back and forth for each lock and bridge pier. Near the easterly end of the line a spare cable is laid across in a trench dug in the mud bottom of the canal to connect the circuits on the north bank to the south bank in case of trouble in either line.

The horizontal water wheels for this plant were furnished by the Wm. Hamilton Manufacturing Company, Limited, of Peterborough, Ont., and operate under a working head of 30 feet. They are arranged in two pairs with a fifth wheel used only in case of high back water, the draft tubes of which pass through the concrete arches below the floor of the power house and empty into what was formerly the river bed of the St. Lawrence, a dam having been built just above the power house by the Government for the purpose of widening the canal, which cuts off the channel between the Canadian shore and Shiek's island, leaving a large lake on the upstream side of the power house, so that with the still water in this lake troubles from ice, which are such frequent evils in connection with most Canadian power plants, will be entirely overcome.

The Cornwall canal is part of the deep waterway system of the St. Lawrence connecting the great lakes with ocean navigation at Montreal, and has locks capable of handling vessels 250 feet long, 50 feet wide and drawing 14 feet of water.

The head race for M. P. Davis's power house is cut from the broad channel leading to the canal waste weir and is paved with stone on a slope of 2 to 1 to protect the banks. A steel frame supports the fine racks, back of which are located the head gates operated by heavy gearing which admit of cutting off the water from any of the four wheel chambers to admit of inspection or repairs of any of the wheels. Valves are provided for drawing off the water after the gates are closed as well as valves for refilling. The gates on the wheels are operated by rods passing through the plates in the bulkhead where they are attached to the Lombard governors for regulating the speed.

Lunch was served at the power house, after which many speeches were made, expressing admiration of Mr. Davis's enterprise and the neat and substantial construction of the power house, as well as the care shown in arrangement of details for convenience of operation and control. Much admiration was also expressed in connection with the Bullock generator and the arc lighting system of the General Incandescent Arc Light Company, of New York.

The return to Montreal was made interesting by the impromptu entertainments and unflagging vigor of Messrs. Aberdee, Lozier and Collyer, representatives of the sales organization of the Bullock. Wagner Manufacturing Company.

MR. WILLIAM CLARK HAWKINS.

Perhaps there is no greater organization in Canada identified with electricity than the Hamilton Electric Light & Cataract Power Company, of Hamilton, Ontario. This company controls and operates the Cataract Power Company, Hamilton Electric Light & Power Company, the Electric Power and Manufacturing Company, Hamilton Street Railway, Hamilton Radial Electric Railway, and Hamilton & Dundas Street Railway. The electric power for the operation of these systems is obtained, as is generally known, from a water power plant at DeCew Falls, near St. Catharines, the current being transmitted to Hamilton, a distance of over 30 miles.

About nine months ago the management of the Hamilton Electric Light & Cataract Power Company was placed in the hands of Mr. W. C. Hawkins, whose portrait is shown herewith. Mr. Hawkins brought to his new position a wide and varied experience. His early days, until 1884, were spent at Taunton, Mass., in the fall of which year a course at the Steven's Institute of Technology at Hoboken was begun. After graduation he spent one year in a machine shop as machinist and a draftroom as draftsman with a firm of printing press manufacturers. For the next year he was employed as assistant engineer on the Third Avenue Cable Railroad in New York City, laying out the roadbed of that company. Upon completing this commission he made a trip to Central and South America, spending the time from September to April in those countries selling and installing turbine plants and coffee cleaning machinery.

From January, 1890, until two years ago, Mr. Hawkins was connected directly or indirectly with the General Electric Company, of Schenectady, N. Y., mostly in the several central stations in which the company had interests. He acted in various capacities, being at one time or other superintendent and manager, engineer, receiver, etc., his duties being principally the physical and sometimes the financial reorganization of the local companies. Prior to coming to Hamilton in July, 1901, a year and a half was spent at the Schenectady works, principally along the line of engineering.

Mr. William Clark Hawkins,
General Manager Hamilton Electric Light and Cataract Power Co.

In his new field Mr. Hawkins will have abundant scope for the utilization of his extended knowledge which so ably qualifies him for the position he has accepted. While he is general manager of the company, it is probable that he will devote special attention to light and power.

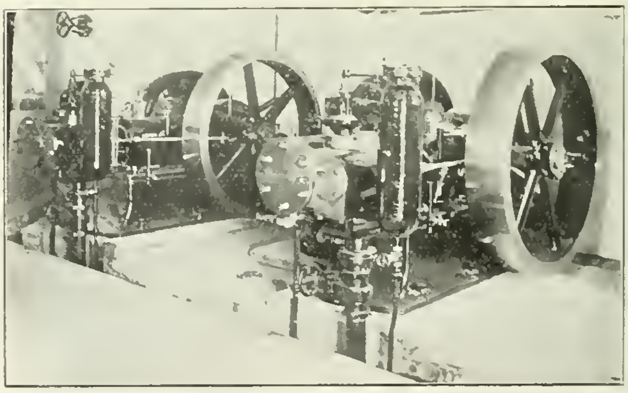
ELECTRIC PLANT AT THE ROYAL MILITARY COLLEGE.

The Militia Department has added to the equipment of the Royal Military College at Kingston an electric lighting plant. The installation was carried out by Messrs. Breck & Halliday, the well known electricians of that city. The plant consists of two direct-connected units and sixty chloride accumulator cells. The generators are of the very latest C. G. type, known as form L. They have a capacity of 25 kilowatts each at 125 volts, and a speed of 305 revolutions. These generators have the improved form of brush holders, with hand wheel adjustment. They are connected to 9 x 10 Ideal engines, manufactured by the Goldie & McCulloch Company, of Galt.

The switch-board is a fine piece of work. It consists of three panels of blue Vermont marble, each 62 x 24 inches and 2 inches thick. Each generator panel is equipped with a Weston round pattern volt and ammeter, ground detector, dynamo and circuit switches, rheostats, etc. There is a storage battery panel, with two divided scale Whitney ammeters and one C. G. E. estatic voltmeter. There are also a main charging rheostat and equalizing rheostat. A double pole, double throw charge and discharge switch, main battery switch, and I. T. E. underload and overload circuit breakers are features of the battery panel. The entire switch-board is equipped throughout with Sach's "Noark" fuses.

Kingston Royal Military College—Power House.

The storage battery consists of sixty cells (chloride accumulator), having a capacity of 400 ampere hours, with a normal discharge rating of 50 amperes. The battery is located in the dynamo room and enclosed in a glass partition. All connections inside the battery room are made with lead encased cables. The battery voltage is regulated by means of a Crouse Hinds end cell switch. The charging of the battery is accomplished during the time of lighting by throwing the cells into two series parallel groups of thirty cells each. The current is controlled by means of a large Cutler Hamer rheostat in the main circuit. An equalizing rheostat of the same type is also placed in the charging circuit to regulate the current passing through each series of cells. After 11 p.m. the load will be comparatively light and will be carried by the storage battery, which will be charged during the hours of lighting when the load on the dynamos is light.



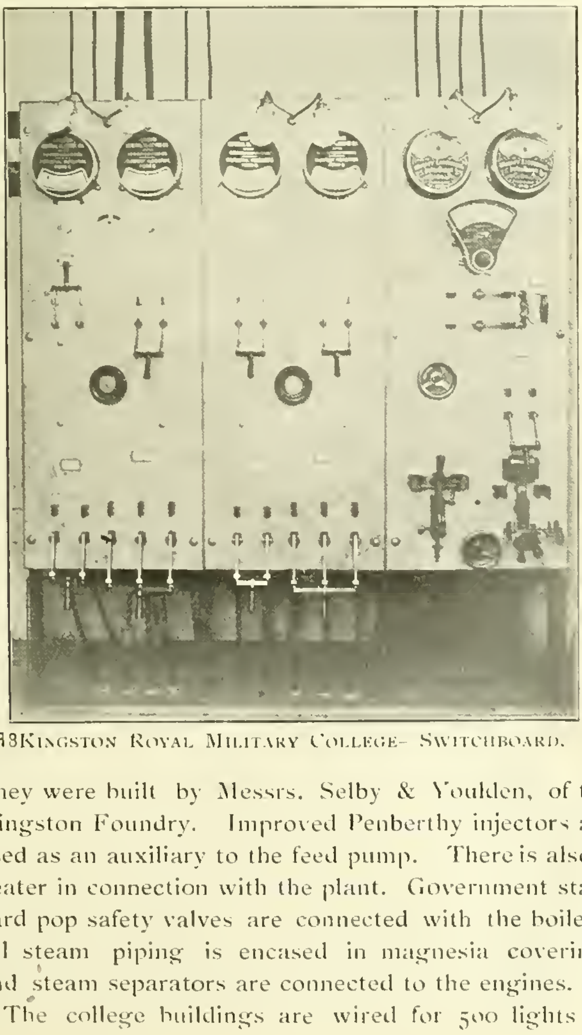
Kingston Royal Military College—Engines and Generators.

The Militia Department has under consideration the advisability of installing an electric pump in the college for fire protection. At present the Kingston Fire Brigade, one mile from the college, has to be depended upon. In the event of the electric pump being placed in position, the storage battery, which will always be kept fully charged, will be utilized to operate the pump motor until such time as steam can be raised and the engines started.

The power house is situated about 1,500 feet from the main building. The current is carried to this building by a 500,000 C. M. cable. The gymnasium, officers' quarters, and hospital are fed from a centre of distribution in this building. There are three separate lines from the power house to supply the avenue, the dormitory buildings and the servants' quarters.

Kingston Royal Military College—Battery Room.

The boiler plant is made up of two shell boilers, each 14 feet long, 48 inches in diameter, of 50 horse power, and equipped throughout with brass mountings.



T98Kingston Royal Military College- Switchboard.

They were built by Messrs. Selby & Youlden, of the Kingston Foundry. Improved Penberthy injectors are used as an auxiliary to the feed pump. There is also a heater in connection with the plant. Government standard pop safety valves are connected with the boilers. All steam piping is encased in magnesia covering, and steam separators are connected to the engines.

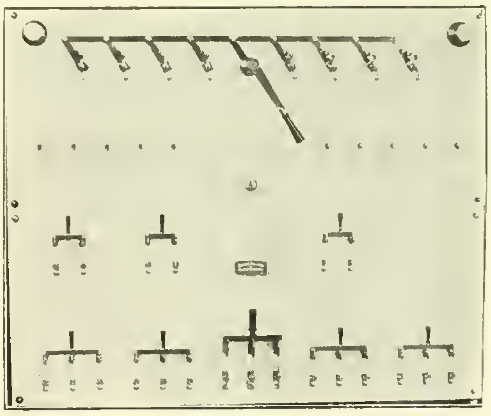
The college buildings are wired for 500 lights of 16 candle-power. The grounds and avenues throughout are at night brilliantly illuminated by arc and incandescent lamps. The plant cost between $8,000 and $10,000, and is the most modern that could be purchased.

The photographs from which the accompanying illustrations were made were taken by Mr. Harry Breck, Kingston.

ELECTRICAL EQUIPMENT OF AN OPERA HOUSE.

Messrs. Breck & Halliday, electricians, have just completed the electrical equipment of the new Grand Opera House in Kingston. The work is quite unique and a credit to the contractors.

The electric power for the opera house is supplied by the Kingston Light, Heat & Power Company, whose plant is situated on Queen street, one-quarter of a mile from the theatre. The switch-board is located at the left side of the stage. It is of the purest white Italian marble, 4 x 5 feet in size, and 1¼ inches thick, and consist of two panels. In addition to the ordinary knife switches, there is a gang of Chase-Shawmut interlocking theatre switches. Ward Leonard dimmers are used, having the interlocking mechanism. The board controls 650 lights, of which one-half are on the stage. Between the various borders, curtains, etc., are four rows of border illuminations, each row 27 feet long, with white, green and red lights, 59 lamps to the row. The foot lights are also wired in white, green and red colors. Connection is made throughout the house for electric calcium light for special effect. The rows and clustered brackets of rosette lamps throughout the house are exceedingly beautiful, and the result is an illumination of surpassing brilliancy.



Kingston Opera House—Switchboard.

A word about the distribution of the lights may be of interest. In the entry way they are in two rows in flower form. In the main part of the house are ten two light brackets, and on the walls and under the galleries 36 rosette lights. Fronting the balcony and gallery are fifty lights in flower form. Over the proscenium front are two rows of thirty and twenty lights respectively. On the stage is every modern device for making theatrical effects, such as moonlight scenes, lightning in a storm, sunrise and sunset, explosions, and calcium colored specialties for tableaux and dancing, etc. Electric bells and gongs are quite numerous.

The wiring is both outside and concealed work, mostly the last named, and under the woodwork and plastering. The wires are all rubber covered. Every precaution is taken again short circuits, and the wires are all arranged in such a locality and way that in case of fire any wire in the building can be located in a moment. They are kept from the plastering and woodwork by porcelain tubes and knobs.

Stage managers from different places, who have visited the opera house, say the electrical fixtures and appliances are superior to those in any other theatre in Canada.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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Electric Railway Commission.

A bill has been introduced in the Ontario Legislature by the Hon. J. M. Gibson, Attorney-General, providing for the appointment of a committee to be composed of the Commissioner of Public Works, (chairman) the Attorney-General and the Commissioner of Crown Lands, with similar powers to those of the Railway Committee of the Privy Council. It is quite proper that electric as well as steam railways should be made subject to control, care being exercised, however, that such control shall not become oppressive and a clog upon enterprise. A stop should certainly be put to franchise and stock gambling, such as has too largely prevailed in the past.

An Interesting Tunnel Project.

The Pennsylvania Railroad Company have decided to solve the problem of access to and exit from New York by the construction of immense tunnels, and have rejected the alternative proposal of the building of bridges across the North and East rivers. The terminal system will be of the most interesting type, and will be operated by electricity, and ventilated partly by the moving of the trains. The president of the Pennsylvania Railroad Company states that after years of exhaustive study, the conclusion has been reached that a tunnel operated by electricity is in every way the most practical, economical and best. The tunnelling of the North river will present many difficulties, for the bed of the river is said to be a soft mass of clay and mud for about 75 feet in depth. The plan proposed might be termed submarine bridge building. A bridge will be built beneath the river bed, supported on piers which will rest on the solid rock, these structures are to be closed in a steel tube. The bridge and the tube, it is intended, shall be constructed simultaneously, and when the time comes for a pier, one will be sunk to the rock and the bridge extended over to rest upon it. Accordingly, the piers and the bridge work and not the tube, will bear the weight of the train. The tunnels will take three years to build and will cost in the neighborhood of fifty million dollars. By some it is predicted that the experience that will be derived by the Pennsylvania Railroad Company in the operation of this portion of their road will result in the adoption of electricity as the motive power on the entire system.

Rights of Electric Companies.

Two judgments have been rendered during the past month which define the rights of electric lighting and power companies under municipal franchises. In the Trial Court at Ottawa, the Ottawa Electric Company brought an action to restrain the Consumers Electric Company from erecting and maintaining poles or wires on certain streets in the city in such proximity to the poles and wires of the Ottawa Company as to interfere with the working of their system. Both companies were granted a franchise by the corporation to erect poles and wires. The Ottawa Company were the first occupants of the streets, although they did not possess an exclusive right or privilege to the use of the streets. The judge held that being first in occupation and using the streets under authority conferred by the corporation, the Ottawa Company were entitled to protection against a company subsequently under like authority using the streets in such a manner as to injure the property of the first occupant. It was further decided, upon evidence submitted, that three feet may be regarded as a safe distance between primary and secondary wires, but that two secondary wires may parallel each other at a distance of from six to nine inches without the slightest danger. The defendants were directed to remove all poles and wires within three feet of those of the plaintiff and were restrained from in future erecting poles or stringing wires closer than three feet to those of the plaintiff. In the case of the Quebec Railway, Light & Power Company vs. The Jacques Cartier Power Company, of Quebec, the decision is by the Court of Appeals. The circumstances are similar to those in Ottawa, excepting that the principal grievance of the plaintiffs is on account of the placing of wires by the Jacques Cartier Company above or under those of the Quebec Company. The defendants were instructed to remove their poles to a distance of three feet from those of the Quebec Company, this decision being in accord with the ruling of Judge McMahon in the Ottawa case. The question of the position of the wires of one company above or under those of another company was, however, regarded in a different light. It was pointed out by the judge that when wires are perfectly isolated they can be placed very close together without danger, but that they do not remain isolated for a long period, as the substance surrounding the wire will deteriorate, nor was the required distance for safety always the same. The accidents which happen might take place when there was only one company, since their wires are one above the other in the same vertical position. The plaintiffs contended that they were not obliged to accept an additional risk from another company, but the judge held that if that proposition were true, no two systems of electricity on the surface of the earth, in the same street, could exist without an understanding between the two companies. Competition would not be possible, and under such circumstances an electric company could not establish itself where telegraph or telegraph wires exist. The evidence, he held, did not establish the existence of any real, actual or immenent danger which would be a violation of the acquired rights of the Quebec company. The opinion of one judge was that the distance between primary wires should at least be six feet, and that crossings should be made at a distance of not more ten feet from a pole. But as experts admitted that even if this plan were adopted the danger would still exist, Chief Justice Lacoste of the Court of Appeals, ruled that the Jacques Cartier Company, were not in fault when their wires and poles were a distance of three feet apart. If we interpret the judgment properly, it is that where an electrical company has priority of occupation, another electrical company is restrained from placing its poles within three feet of the poles of the original company, but that the law will not protect the wires of one company from interruption by those of another company as the result of their being placed too close.

The bill to incorporate the Ontario Electric Railway Company has been passed by the Ontario Legislature. This company proposes to build an electric railway from Cornwall to Toronto and from Brockville to Ottawa, the capital stock to be $5,000,000, bonding power $20,000 per mile, and expected cost of construction $8,000,000. The first directors are Sir Richard Cartwright, Cornelius Birmingham, Robert Carson, and John Carson, of Kingston; A. L. Jewell and George E. Smith, of Boston; and H. W. Smith, of Salem. The head office is to be in Kingston.

FAST VS. SLOW RUNNING ELECTRIC METERS.

While in the United States 25 per cent. of lost current is charged to slow running meters, and the experience of most lighting companies in Canada seems to show that slow running meters are the rule, the report of the government Inspection Department at Ottawa states that the greater number of electric meters tested were found to run fast. Mr. Higman, chief electrical engineer, whose attention was called to this circumstance, writes the following in explanation:—

OTTAWA, February 7th, 1902.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—In reply to your letter of the 5th instant, I beg to state that the departmental report in question is made up of returns furnished by the inspectors from actual tests made. A certificate of the test of each meter showing the percentage of error—fast or slow—is furnished to the supply company and there would seem to be little excuse for views being entertained contrary to the facts which these certificates disclose.

The following tabulated statement has been carefully prepared from quarterly returns made by the inspectors during the fiscal year ended on 30th June, 1901.

Districts.	Number presented.	Verified as coming within the Error tolerated by Law.			Rejected.			Verified after first reject'n as coming within the Error tolerated by Law.		
		Correct.	Fast.	Slow.	Unsound.	Fast.	Slow.	Correct.	Fast.	Slow.
Belleville	205	140	37	28						
Hamilton	578	404	42	72						
London	420	100	177	145		1	2	1		
Ottawa	809	86	249	462	6	2	4			
Toronto	761	106	282	176		2		62	55	78
Montreal	2,212	1,209	671	196	47	6	10	2	66	5
Quebec	1,633	564	574	492	2			1		
Sherbrooke	139	30	54	55						
St. John	398	73	205	120						
Halifax	458	368	97	16	2	23	4	5	2	1
Winnipeg	264	74	45	145						
Vancouver	691	226	177	288						
Victoria	349	98	149	102						
Totals	8,923	3,478	2,759	2,297	57	34	20	71	123	84

The meters shown under the heading "Verified as coming within the error tolerated by law" are really all correct, that is they were found legally to be either fast or slow, all being within the 3% allowed by the law. As an illustration let us take the work done in the Belleville district. The total number of meters presented was 205; of this number 140 were exactly right, 37 were less than 3% fast and 28 were less than 3% slow, but all were really correct under the law. The bulk of these meters are adjusted and tested by the supply companies before being submitted to the inspector for his test and if they run a little fast or slow it is because they have been so adjusted. A number of the companies prefer to send out their meters slightly fast in orde to compensate for the tendancy to slow up. Meters under the heading "Rejected" are mostly disputed meters and com directly from the consumer. Those coming under the head "Verified after first rejection, etc.," are of the same class but were not unsound and after being adjusted by the owners, tested out as shown.

It will be observed that out of a total of 8,923 meters presented 8,534 were found to be correct, leaving 389 or less than 5% for repairs and readjustment. This good showing is due, doubtless, to the Government Inspection, for if it did not exist supply companies would not give the same attention to the cleaning and adjustment of their meters that they now do. This fact was fairly well illustrated by the results of the first year's work under the Inspection Act, when nearly 50% of the meters tested were found to be incorrect. I am,

Your obedient servant,

O. HIGMAN,

Chief Electric Engineer.

The annual meeting of the Capital Power Company, Limited, was held in Ottawa on February 7th. Although only one-half of the company's plant was in operation last year, the financial report made a satisfactory showing. Officers and directors were elected as follows: President, E. B. Eddy; vice-president, Baeile Carriere; secretary-treasurer, H. A. Burbidge; A. W. Fraser and W. H. Rowley.

It is expected that work will commence this summer on the construction of the proposed electric railway between Thorold and Dunnville, Ont., for which a charter has been obtained by the Niagara District, Wellandport, and Dunnville Electric Railway Company. Messrs. James and David Battle, of Thorold, and William M. German, M P., of Welland, are directors of the company.

QUESTIONS AND ANSWERS

"J. H. R.," Oxford, N. S.: Could you inform me what the necessary requirements are to become a member of the "Stationary Engineers' Association," and would a personal application be necessary, as in my position and circumstances that would be almost impossible. I have now had twelve years successful experience in steam and electrical engineering, but have never yet attempted to secure papers. I am in charge of the electrical plant and could only leave for a very short time.

Ans: The Ontario Association of Stationary Engineers have power to grant certificates to all who may apply and prove their efficiency by passing the examination of the Canada Association of Stationary Engineers. The latter association, by resolution of the board, in conformation with the law, are not permitted to furnish applicants with copies of previous examination papers. Any member of the Board of Examiners may examine an applicant, using the prescribed form of questions. The answers must be written by the applicant and forwarded by the examiner to the Registrar, who must show the papers to two members of the board and receive their approval before certificate is issued. Thus you will see that it is necessary that the applicant must appear in person before some member of the board. Mr. O. P. St. John, of the Boiler Inspection & Insurance Company, Toronto, is president of the Board of Examiners. The Registrar is Mr. J. G. Bain, 113 Yorkville avenue, Toronto.

"Induction" writes: I am in receipt of my copy of Electrical News for February, also replies to my questions. Re full load capacity of 400 k. w generator, your answers do not compare with those received by another electrical journal, a copy of which I enclose. Please take up the questions again and give me your opinion regarding the transformers also. The question is of importance to me and I would therefore like to know why there should be a difference of opinion. The answer from the other journal I speak of is as follows: It will not be advisable to carry the current of your three-phase generator beyond its rated value, namely, 382 amperes. The kilowatt rating of the machine is based on its being run at the rated voltage, and the fact that you have reduced the field excitation or the speed, as the case may be, does not make the armature capable of standing any more than its rated current.

Ans.: We have gone over your questions again and fail to see wherein we are wrong. The heating of one part of the machine, say the armature, is affected by the rise in temperature of the field, and vice versa; thus, if you have decreased your field current, and thus your field heating, you will get a somewhat smaller temperature elevation in the armature, or in other words, be able to carry a slightly greater armature current for the same maximum temperature. You do not ask any question about the transformers, so we are at a loss to know what is the point on which you need an explanation. If you desire detail figures on the probable performance of the plant under varying conditions, we would suggest that you consult the manufacturers, as it is not possible for anyone but them to give anything other than a general opinion.

"Reader," St. John, N. B.: Could you give me any information as to whom to apply to secure an engineer's license?

Ans.: In order to obtain an engineer's license it is necessary to appear in person before one of the examiners of the Ontario Association of Stationary Engineers. Mr. J. G. Bain, 113 Yorkville Avenue, Toronto, is Registrar of the Association.

"A.H." writes: We have in our electric light plant an engine with a stroke of 12, engine travelling 275 r.p.m. with a piston 10⅝ inches in diameter; boiler pressure 100 pounds; boiler 11 feet long, 4½ feet in diameter; fifty-four 3 inch tubes, with about one-half the shell exposed to the fire. Could you give me the horse power of engine and boiler?

Ans.—The manufacturer's rating for a boiler and engine of the sizes you name would be about 50 h. p. for the former and 60 h.p. for the latter, these outputs being the most economical loads. If desired, they could be increased by any amount up to say 25 per cent., though the efficiency under the increased duty would be somewhat less.

"Station Manager" writes: Can you tell me whether any of the lighting companies pay their executive officers a percentage on the increase of revenue (either gross or after deducting operating expenses) in place of increase of salary as the business grows? I have been informed that such was the case and that in some instances the officers receive a fixed salary with a percentage on the increased revenue for the current year over the previous year as a sort of bonus; when no increase is shown no bonus is given. There are, of course, arguments for and against such a system as I mention, but I would like to find out if possible whether such a thing is done at all by any of the Canadian companies.

Ans: The custom of lighting companies is to pay straight salaries, and we know of no instance in which an arrangement of the kind you mention is in force. We shall be glad, however, to hear from any of our readers who know of any instance of the kind.

"C. W. C.," Rat Portage: I am looking for an advertisement of some electrical company who make a specialty of electrical apparatus for cooking and heating. I want to know if heating with electricity with water horse power at $5 per h. p. per year is cheaper than wood at say $3 per cord.

Ans.: It is difficult to pronounce very accurately on this question, but we would estimate that under average conditions, even at the extremely low figure of $5 per horse power year, electric heating would cost three to six times that of wood. Any of the dealers in electrical supplies will doubtless be glad to furnish you with all the information you desire on electric heating and cooking apparatus.

The annual report of the Department of Railways contains for the first time some statistics of the electric railways of the Dominion. These total 675 miles of track. The paid-up capital of the companies is $39,076,016; gross earnings, $5,768,283; working expenses, $3,345,163; net earnings, $2,333,120. Ontario has 386 miles; Quebec 197 miles; British Columbia 51 miles; Manitoba 18 miles; New Brunswick 12 miles; and Nova Scotia 10 miles.

INSPECTION OF INTERIOR WIRING.

Editor ELECTRICAL NEWS

DEAR SIR,—In this age when all things advance with lightning speed, it becomes important to have such advances made in the proper direction, and that such advances should be safe, and as perfect as our trade, profession or art knows how. To accomplish this in the electrical business it is necessary that the ignorant public be convinced that an electric current is not so deadly a force as they at present suppose.

I have said that the public are ignorant, but I meant in the uses of electricity, as I find proof of such ignorance every day. I will endeavor to give you some of the ridiculous as well as amusing ideas of the people using electric current.

One man whose house I had occasion to inspect before our company made connection, wanted to know when was I going to bring the light, and requested that when I did "bring the light to bring it not too strong, as his eyes were weak, and he did not care for extremely bright light anyway." Another instance where a house was wired, concealed and located in that part of the city where people are supposed to be educated, I was making an extensive test for ground with a magnet; the lady of the house seemed quite interested in the operation, and I presume she was impressed with the whirl of the wheels in the box; after displaying some agitation she exclaimed: "I would not put so much electricity in the wires if I were you, because we will not be in here for a few days, and by the time we want the light it might have escaped, and we would have to send for you again.' As ignorance is bliss I did not arouse her from her dream, but assured her that the current I sent into the wires was everlasting, without mentioning that our "gang" would connect the house that same day.

Another lady asked me what was the best way to get the "oil out of a 16 c. p. G. E. lamp, as she wanted to make some crochet fandangle work on it with balloon effect, and I contented her troubled brain by saying that the oil would evaporate during the process of crocheting. Another case reported to me by our "trouble man" was a complaint from a customer that they could not get light in their basement. Investigation revealed a broken wire in a stretch of about fifteen feet with no cleats. He questioned the servant, who said that she had hung up some clothes on the wire on the previous night, and that in the morning all the nice clean washing was on the floor. He cautioned her against doing this, and she replied that she never did care for that kind of a hanger as the black stuff (insulation) invariably left a stain.

Aside from the public being a little troublesome, I find there is considerable annoyance caused by the fire insurance companies. In case of re-inspecting a customer who was "connected up" when, perhaps, inspections were not so rigorous and exacting, sometimes certain insurance companies will call in an expert to get his idea as to the quality of the risk, but usually they omit the expert and his expense, and will send one of their own inspectors from the clerical staff in the office—who has graduated from licking postage stamps, and this inspector will pass some of the most dangerous electrical conditions as being perfect and assures his client that all is satisfactory. When the practical man comes on the scene, he is given the laugh; in fact, I have seen some people get very angry at me and say that the insurance inspector got there first and pronounced all things perfect. If the man in question has the assurance that all is O. K. with the insurance company, what need he care?—nothing, of course, but if he is reimbursed for a fire loss it will not make amends for burnt out transformers, loss of adjoining buildings, some perhaps containing comfortable homes, not insured, loss of life, and in fact many things which are the direct result of just such negligence.

It would be gratifying to know that such fire insurance companies would re-instate these office boy inspectors, let them go back to the postage stamp and opening of the head clerk's mail, then get practical men, who are qualified from long experience and are capable and reliable.. This will be one means of preventing "electric fires."

Now, a word as to newspaper reporters. I have known cases where the words "Electric Fire" were printed in large, black, scarehead letters in the daily papers reporting a fire supposedly originating from electric wires, where there were no wires in the building nor were there any wires within a few hundred feet of the building. In the face of such reports, circulated by the thousand, it is rather difficult to convince the timid people that electric house lighting is an improvement on the antique tallow dip, and furthermore it is one of the greatest impediments to the progress of the art, and a financial loss to those engaged in the electric light and power business, because people fear the disaster of a fire.

The botch or mushroom electrician is another source of trouble. These people sprout, and launch themselves into the trade with no preparatory training whatever. They are the greatest evil that our business has to contend with; they cut prices and take the work away from responsible contractors. They use cheap and inferior materials. Their work is rough and does not last; in fact they are a constant annoyance to all who have any dealings with them. The species of mushroom electrician has many varieties known only to inspectors who have made a study of this class. Then there is the plumber, the steamfitter, the uneducated steam engineer, the carpenter, the machinist, and last but not least, the iceman. But the most vile of all I have known is the handy man who knows it all. These parasites could be prevented from feeding off us, and the only way to accomplish this is through the Councils of our cities, by having laws passed that no incompetent man be permitted to do electrical work, and, as is done in many States across the border, all should be examined before an appointed board. If they are satisfactory a certificate is issued but not until then are they allowed to work. Also people intending to have electric light or power on their premises must get a permit, as is done now for boilers, building, etc. Is not an electrical installation as important as a steam engine and boiler? Is not precaution necessary to life and property? If so, laws should be made accordingly, either through municipal amendments of city charters, or by act of Parliament. I understand that an act respecting electric wiring is to be tried in Toronto. I wish Toronto success. Then the other cities will not be backward in following and the trade will be elevated to the level where it belongs.

Peculiar to note that in the book of the National Board of Fire Underwriters of the United States, adopted by the Canadian Board of Fire Underwriters; all through this valuable little code there are provisions made for many contingencies, principally against fire, but I have yet to see where the Canadian Board of Fire Underwriters make any provision for protecting life further than to state that a certain amount of insulation shall be used, here, there and everywhere.

During the past year a few cases have come to my notice where people where killed outright by making a grounded circuit with their body. In Montreal a short while ago a saloon keeper was killed in this manner. Again in Montreal a few months ago a man was killed in the furnace room with a ground. Then, a few weeks subsequent, a banking clerk was killed at the vault door, ground again. In all these instances there was the brass socket in evidence. Had these sockets been porcelain, or some other absolute non-conductor, these three lives would not have been lost. There seems to be a prevailing delusion that a brass socket is just the thing—so it is in its place, but it should not be used where there is the least possibility of making a contact with "grounded" conductors while being handled by living creatures. Those brass sockets should be barred out in all such cases, particularly in basements having ground or cement floors.

Some wiseacres contend that cement is a non-conductor, but that idea should be left at the seaside. Cement is not always dry, and no one can give a positive assurance that it will remain dry, even though it may be perfect at the time of inspection therefor.

It would be well for the lighting companies to find the moral—Prevention is Superior to Cure. Absolute non-conductive shell sockets are more easily obtained than the riddance of a law suit for loss of life from a broken down transformer, which in its playful moments, allows the primary voltage to get over on the secondary side.

Here endeth the first lesson.

Yours truly,
"INSPECTOR."

In our advertising columns will be found an interesting announcement by the Pittsburgh Transformer Company, of Pittsburgh, Pa. The subject matter of their display consists of the relation which exists between the durability of a transformer and its real efficiency. The well known reliability of this company's product gives special weight to the remarks made concerning tranformer performances. The company makes the claim that in the many thousand lights of transformer capacity which they have shipped to Canada annually, for the past four years, but a total of three transformers have ever been reported burning out from any cause whatever. This would indicate that their claims for the durability of the Type K are being well substantiated.

If you have any doubts about the value of the Canadian Hand Book of Steam and Electricity, drop a post card to the publishers, The C. H. Mortimer Publishing Co., of Toronto, Limited, Toronto, Canada, asking for a copy of table of contents. It is the best book in the market. Price, only 50 cents.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,

MONTREAL, March 5th, 1902.

February 1st ushered in one of the worst snow-storms that we have known since the time of the relief of Ladysmith, when the Montreal Street Railway was "stalled." Although the effect in the end was virtually the same as far as the conveyance of passengers was concerned, yet the fight put up was simply grand. The general public have an idea that the Montreal Street Railway are generally caught napping by the first heavy winter snow-storm, and to a certain extent this in the past has not been far out. However, Saturday and the two following days saw a ceaseless fight. The sweepers hammered at it until brooms were well worn, ploughs assisted, shovellers, etc., night and day, and had the city been prompt (as they should have been) in removing the snow everything might have been kept running. As it was, however, pedestrians, vehicular traffic of all kinds, and the Montreal Street Railway were using the "swept centre" of the road, it being the only possible thoroughfare. This threw the cars out of schedule, besides re-depositing snow on the rails. Monday evening business men got their cars home as usual.

The Montreal Street Railway proposed to the City Counci that they remove the snow as piled to the sides of the track by the electric sweepers. At present the arrangement is that the city cart it away and the Montreal Street Railway pay their share of the expense. As the Montreal Street Railway propose to run full trains for removing snow, at night, aided by machinery (probably large scoop shovels electrically controlled and swinging in by means of motor a ton of snow at a scoop) there can be no question of the speed of such a system. Naturally there is a howl from the snow carter, but yet we have the City Surveyor's own word for it that these same carters won't come to the west end to cart the snow. The question would be settled to the benefit of interested citizens respectively by giving the west end clearing to the street railway and the east end to the man and his horse.

Some United States electrical periodicals, having quite a number of Canadian subscribers, might pause for an instant in their criticism of foreign practice. Any possible English attempt is, of course, held up to ridicule and often treated to sarcasm and unmerited abuse. If Canadians would simply drop them off and give their reasons for so doing, it might be a lesson to some of them to be a little more "just" and "cosmopolitan."

ANNUAL MEETING CANADIAN GENERAL ELECTRIC COMPANY.

The statement presented at the annual meeting of the Canadian General Electric Company, held on February 24th, shows that the volume of business transacted during the year ending December 31, 1901, was very much larger than any preceding year, and that the current year began with more orders on hand than at the beginning of any previous year. The balance at credit of profit and loss amounted to $612,028.94, which is made up of $345,990.03 profit on operating (being an advance of 30 per cent. over the year 1900), $195,000.00 premiums on new shares issued, and $71,038.91 brought forward. From this amount dividends of 10 per cent. on the common stock, and 6 per cent. on the preferred stock, amounting to $166,750.00, were paid, $100,000 transferred to contingent account, and $77,680.27 remains at the credit of profit and loss.

During the year new buildings and plant were added to the Peterborough works, the Montreal works were reorganized, and a 1,200 horse-power water-power secured at Peterborough. The completion of the new plant at Toronto Junction will, it is stated, enable the company to handle the greatly increased business in prospect.

The directors were re-elected as follows: W. R. Brock, M.P., president; H. P. Dwight, first vice-president; Frederic Nicholls, second vice-president and managing director; Hon. George A. Cox, J. K. Kerr, K. C., Rodolphe Forget, W. D. Matthews, Herbert S. Holt, E. B. Osler, M.P., Robert Jaffray, James Ross, Sir W. C. Van Horne, K.C.M.G.

ANNUAL MEETING TORONTO RAILWAY COMPANY.

A very satisfactory statement was presented at the annual meeting of the Toronto Street Railway Company recently. The company's gross earnings for the year 1901 amounted to $1,661,017.50, an increase of $160,016.22 over the previous year. The operating expenses were $857,612.10, an increase of $81,931.28 over 1900. The operating expenses were 51.6 per cent. of gross earnings, against 51 per cent. for 1900. The increase was due to an increase in the wages of employees and to the operation of an additional number of cars. The net earnings were $803,405.40, an increase of $78,384.94 over 1900. The statement showed a net profit of $510,726.92, as compared with $454,162.85 for the previous year. After deducting pavement charges paid to the city and dividends of 4½ per cent., the balance is $172,726.92.

During 1901 the company carried 39,848,087 passengers, or 3,786,220 more than in 1900. The transfers granted show an increase of 1,179,334.

The rolling stock was increased during the year by 80 motor cars, constructed at the company's workshops, and additional cars are now in course of construction to meet the expected increased business of the present year.

In the election of directors Messrs. F. L. Wanklyn and C. E. Porteous were replaced by Col. H. M. Pellatt and Mr. Frederic Nicholls. Mr. Pellatt is president of the Toronto Electric Light Company, and Mr. Nicholls is general manager and second vice-president of the Canadian General Electric Company. The following is the new board: William Mackenzie, President; James Ross, vice-president; Hon. George A. Cox, W. D. Matthews, James Gunn, H. M. Pellatt and Frederic Nicholls.

SHEIK'S ISLAND POWER PLANT.

The reference in our February issue to the visit of electrical engineers and other interested persons to the power plant of the St. Lawrence Power Company at Sheik's Island, near Cornwall, Ont., was somewhat misleading, inasmuch as it should have stated that the party were the guests of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, and not of Messrs. Collyer & Brock, who have no connection with the Bullock Company. The Bullock company installed the electrical apparatus and the visit was made for the purpose of witnessing its operation. Mr. A. Collyer is district manager at Montreal for the Bullock Electric Manufacturing Company.

VERDICT AS TO BOILER EXPLOSION.

A boiler explosion occurred in the pump factory of Angus McLeod at Portage la Prairie, Man., on February 15th, by which Duncan McLeod was killed. According to the evidence of the owner of the factory, there were only ten pounds of steam on an hour or so before the explosion, and scarcely any fire had been put on in the meantime. He also stated that a safety valve had not been used on the boiler and that it had not been inspected by Government Inspector. The following verdict was brought in by a jury: "That Duncan McLeod met his death by the explosion of a boiler in Angus McLeod's pump factory which explosion, we find, was caused by too great pressure of steam; that the said boiler was being run without a safety valve; that the said boiler was being run without proper Government inspection; that the said boiler was defective.

SPARKS.

A meeting was held in Cornwall, Ont., recently when Mr. M. P. Davis, proprietor of the Sheik's Island power plant, had a conference with the town council regarding the securing of new industries for Cornwall, to be operated by electric power. Mr. Davis stated that at 10 days notice he could supply 600 horse power, in a slightly longer period 1,200 h. p., and in a few months 4,000 h.p. The plant will develop 4,000 horse power, but at present it is only furnishing light to the Cornwall canal.

Attention is directed to the advertisement of Messrs. Johnson, Willats & Co., 192 King street west, Toronto, branch office, London, England, importers and exporters of Canadian and East India mica in white, rose, light and dark amber for commercial, manufacturing and electrical purposes. This firm make a specialty of stamped solid sheet mica segments, cut to any size or shape required, solid sheet mica washers and bushings, and solid mica rings for all commutators. They also handle the agency for the Dominion of Canada, for kant krack mica chimneys, for Welsbach and Auer lights. Messrs. Johnson, Willats & Co. are now in a position to furnish mica to the trade in any design, shape, pattern or form.

TELEGRAPH and TELEPHONE

THE LATE C. W. LUNDY.

Some particulars have come to hand of the life of the late . W. Lundy, of Halifax, N. S., superintendent of the Direct United States Cable Company, whose portrait appeared in last number Mr. Lundy was an Englishman, and in the early days of electricity he decided to make electrical work his profession. His life was spent in the cable business. He saw service on three continents and was present at the laying of the Atlantic cable in 1895. The first cable across the Atlantic was laid in 1858, from Ireland to Newfoundland, but it proved a failure. Seven years later the famous steamer Great Eastern started to lay the second cable. On August 2, 1865, when about two-thirds of the distance between Valentia, Ireland, and Heart's Content, Nfld., was covered, the cable broke in 15,000 feet of water. It was, however, recovered a few weeks later, and communication was established for the first time between Europe and America.

Mr. Lundy, who was then in the employ of the great firm of Siemens, the constructors, was aboard the Great Eastern during the laying of the cable, and after its completion had the honor of receiving the first trans-Atlantic cablegram which announced the wreck of a Cunard liner. The message which is in Mr. Lundy's handwriting, and bears his signature, is preserved in the archives of the company.

At the age of twenty-two Mr. Lundy was superintendent of the Anglo-American Cable at Heart's Content, Nfld., the first cable station in the new world. Thence he was transferred to Madras, India, where he spent several years in the employ of the Eastern Company.

In 1874 the Direct United States Cable was laid across the Atlantic from Ireland to the Novia Scotia coast, the landing being made at Tor Bay, a lonely spot in Guysboro County. One year later Mr. Lundy came out as superintendent, and that important position he held continuously until his death. In 1890 the Direct Cable was continued to Halifax. The station at Tor Bay was abandoned after fifteen years' occupation, and the American headquarters were established at Halifax, which was thereby put in direct communication with the Old World. Since that date Mr. Lundy has resided in Halifax, N.S., occasionally going home to England on short furloughs.

ANNUAL MEETING BELL TELEPHONE COMPANY.

The annual meeting of the shareholders of the Bell Telephone Company was held in Montreal on February 26th, at which the statement presented was considered satisfactory. The report in part stated:

"Four thousand four hundred and ninety-eight subscribers have been added during the year, the total number of sets of instruments now earning rental being 42,858. The company now owns and operates 343 exchanges and 514 agencies. Two thousand eight hundred and forty-three miles of wire have been added to the long distance system in 1901; of these, 1,303 miles are in the Ontario department, and 1,540 in the eastern department. The long distance lines now owned and operated by the company comprise 24,193 miles of wire on 6,634 miles of poles.

The revenue account showed the receipts for the year to have been $1,851,535.22, and the expenses of operating $1,324,424.53, together with other expenses, making $1,433,799.41, left the net revenue $417,735.78. From this $400,000 dividends were paid to January 15, 1902, and the balance was $17,735.78. The balance of revenue from 1900, of $74,085.87 added to this made $91,821.65. Written off plant and patent account was $50,000, carried to insurance reserve $10,000, and to accident reserve $10,000, leaving to be carried forward ty 1902, $21,821.65.

Applications for the construction of long distance lines are constantly being received, such lines, particularly in sparsely settled districts, being of great value to the public; but our expansion in that direction has been checked because of lack of captal for construction purposes. The shareholders, at a special meeting held on December 5th, 1900, authorized application to Parliament for power to increase the capital from $5,000,000 to $10,000,000, and this matter is receiving attention."

In explanation of the proposed increase in the capital stock of the company, the president, Mr. C. F. Sise, stated that the surplus revenne was not sufficiently large to meet the requirements of the increasing service which the company had had to keep up with. He mentioned that during the coming year something like one million dollars would be needed to make the extensions required. They were inaugurating a long distance service in the Northwest at present, which gave promise of being a great benefit to the people in that section as well as being of profit to the company.

The annual report was unanimously adopted, and at the close of the meeting the following directors were re-elected: Messrs. C. F. Sise, F. P. Fish, W. R. Driver, Boston, Hugh Paton, Hon. Robert Mackay, Charles Cassils, and Thomas Sherwin.

TERMINAL BUILDINGS FOR PACIFIC CABLE

The site is being cleared for the new terminal buildings for the new Pacific cable line to Australia which are to be erected on the west coast of Vancouver Island, on Barkley Sound. The site of the buildings is a beautiful peninsula where Banfield creek flows into the Sound. The property consists of about 160 acres. The approach to the landing from the sea is over an ooze bottom which will make an ideal bed for the cable.

The plans for the buildings were prepared by F.M. Rattenbury, architect, of Victoria. The main building will be 100x120 feet T shaped, one arm being devoted to the office for the cable telegraph and land telegraph suites of offices, and the other wing to the residential section. There will be separate laundry buildings and a bungalow for the manager. The buildings will be illuminated with electric light, and a water service will be provided by laying a pipe to a mountain stream several miles away.

The cable will be 7,986 miles in length, and the cost of laying it will exceed $8,900,000. The contract for laying the cable was awarded some time ago to the Telegraphic Construction & Maintenance Company, and the following is the route: Vancouver Island, B. C., to Fanning island, 3,561 miles; Fanning island to Suva, Fiji, 2,903 miles; Fiji to Norfolk island, 961 miles; Norfolk Island to New Zealand, 537 miles; Norfolk island to Queensland, 834 miles.

The manufacture of the cable has already been commenced The first expedition in connection with the laying of it is expected to leave the Thames this month. This will include the laying of the section of the cable from Queensland to Norfolk Island, Norfolk Island to New Zealand and Norfolk Island to Fiji Islands. The ship being built for the purpose will be called the Colonia. The size of the vessel may be gathered from the fact that a portion of her equipment will consist of 5,000 tons of cable, a far greater load than the Great Eastern was capable of carrying.

SHORT CIRCUITS.

The shareholders of the People's Telephone Company, Sherbrooke, Que., have approved of an issue of $25,000 preference stock.

The directors of the Windsor Hotel, Montreal, have decided to install the Bell Telephone system in 400 rooms of the hotel, and to have the instruments connected with the long distance service. A private branch exchange will be installed in the rotunda office.

The Minister of Finance laid on the table of the Dominion House last week the correspondence which had passed between the government and Mr. William Marconi regarding wireless telegraphy. Mr. Marconi makes the following proposition: The Marconi Wireless Telegraph Company is to erect two stations, one in England and the other in Nova Scotia, with the object of carrying on communications on a commercial basis between the Dominion and Europe. The Government is to agree to contribute $80,000 for the erection of a station in Nova Scotia and all messages to be sent over government telegraph line at rates not higher than those charged for ordinary commercial messages. The company agrees to transmit messages between Canada and the United Kingdom at rates which shall be fully fifty per cent. less than the rates now charged for cable messages between these countries; in other words, a reduction from 25 cents a word to 10 cents a word, while for the Government and for press messages the rate is not to exceed 5 cents a word. The Dominion Government has accepted the above proposition which has been likewise approved by the directors of the Marconi Wireless Telegraph Company.

ENGINEERING and MECHANICS

HEAT CONTROL.

On February 15th, a lecture was delivered in the Engineers' Hall, Victoria street, Toronto, before the Toronto Association of Stationary Engineers by Professor Warren S. Johnson, of New York, president of the Johnson Electric Service Company. There was a good attendance of architects, engineers, and other interested persons. The subject announced was "Heat Control", but the speaker confined his remarks more to an explanation of the conditions under which we live than to methods of controlling heat. Five things, he said, were necessary to human life, namely, air, heat, water, food. and moisture or humidity. Brief reference was made to the component parts of air, during which he stated that the impression that carbonic acid gas is poisonous was an error.

The second element of life, Heat, was dwelt upon at some length. Prof. Johnston said that it was now admitted that heat was simply a wave. The universe is supposed to be filled with light ether, very fine in its constituent parts. These waves are of various lengths, the longest being electricty ; the others in the following order : Heat, Light, Chemical-acting, Roentgen. When these waves strike us they are called Heat. Electric waves travel at a speed of 186,000 miles a second. The longest electric wave perceived is 15,000 miles : two of which would span a space between Toronto and San Francisco. Some heat waves, the speaker said, were very short. All heat passed out in straight lines, the same as light, and wou'd also pass through glass in the same manner. An explanation was given of the Fahrenheit scale for measuring heat, it being shown that at 480 below zero there would be no heat waves.

After a few words as to water and food, Professor Johnson passed on to the fifth element of life, moisture. He stated that it was not water, but gas, and that all air contained humidity, the latter being entirely separate from the air. An attempt to live in an atmosphere devoid of humidity would bring death in short order. Moisture in air had many peculiarities. One of these was that when there was a certain quantity in the air it would take up no more. This point is known as saturation, and marks 100 on the scale of the hygrometer, so that the range of humidity is from 0 to 100 per cent. The matter of percentage of moisture depended, however, on the temperature. The warmer the air the greater amount of vapor it will require to give the same percentage of moisture, and vice versa. The average humidity of outside air is from 70 to 80 per cent. ; on rainy days it would be about 100 per cent. Also it would be greater in January than in July. Supposing the humidity of the air in a room to be 80 per cent., and the outside temperature 32 degrees ; if you raise the temperature 17 degrees the humidity would be only 40 per cent ; then raise it 17 degrees more and the humidity would be only 20 per cent.

The necessity of moisture, the speaker said, was not generally recognized, yet it was a curious fact that it is only through the moisture in the air that it retains heat. If the air has little or no moisture in it the radiated heat goes through it without warming it. If there were no moisture everything would freeze at night when there is no sun. As to the amount required in a room, if it was too great it would freeze on the window. One pound of water would humidify 4,000 cubic feet of air. In school buildings 50,000 cubic feet of air per minute, and a humidity of 40 to 45 per cent. is required. This would take two tons of coal and 500 pounds of water. The temperature of schools, residences, etc., for comfort should be about 70 Fahr ; if 5 degrees less it wi l be chilly and if 5 degrees above, too warm.

Professor Johnson said that until twenty years ago there was no method of controlling the heat of a room except by fueling. He then began experimenting in a school building where he was professor, and, as is generally known, had since invented regulators for the control of both heat and humidity. By means of apparatus brought with him for the purpose, he demonstrated to the audience the delicate yet reliable working of his devices, which he said had been placed in several buildings in Toronto.

In reply to questions, Professor Johnson stated that hydrogen could be compressed to a liquid, and that a Marconi wave would cross the Atlantic in 93-thousanth part of a second. The fastest electric wave would pass seven times around the world in a second.

A hearty vote of thanks was tendered the speaker for his address, which was much appreciated.

STEAM PIPES.

The importance of attending to the quality and security of steam pipes is being strongly emphasized by the frequency of accidents which have happened of late to that part of an engine's equipment. Many hints regarding this matter will be found in the memorandum presented by Mr. C. E. Stromeyer to the Manchester Steam Users' Association. He has found that many of the fittings sold as cast steel are of less strength than cast iron. There will always be a doubt regarding steel castings so long as they are liable to have many blowholes which are not apparent on the surface. There are some steel works, however, which turn out fairly good steel castings of uniform soundness, so that we may infer that blowholes are not altogether inevitable. The great evil is water-hammer in pipes and valves, and this is illustrated by a case in which the plug of water struck the brass valve of a junction valve, turned it inside out, and drove it through its seat into the boiler, which at that time had a full pressure of 150lb. per square inch. The valve casing was not fractured. Horizontal lengths of pipe with an upward bend at one of the ends have proved extremely dangerous if they can become completely filled with water. If the steam be turned on to be in contact with the water in a vertical pipe, and if also the water in a horizontal length be allowed to drain out until it sinks below the inside top of this pipe, then the steam rushes into the space above the water, sweeping up waves which set the entire mass into violent motion, and causing it to oscil'ate backwards and forwards, until it strikes the valve and shatters it. Expansion bends are of several forms. There is (1) the inverted ∩, consisting of a semicircle and two straight pieces, each joined to a short quarter-bend ; (2) the semicircle joined to two quarter-bends of the same radius as itself ; (3) the bend consisting of one piece of two-thirds of a circle, and two pieces of about one-third each ; (4) the complete circle ; (5) the complete circle set at right angles to the axis of the steam pipe, and stressed in torsion. If the permissible springing of No. 1 be represented by 2 2-3rds, then that of Nos. 2, 3 and 4 would be 12, and that of No. 5 would be 21. The permissible amount of stretching of any of these bends is directly proportional to the mean height of the loop, and inversely proportional to the square of the diameter of the pipe, and independent of the thickness of the metal, but the force required to effect the stretching is proportional to the thickness of the metal and to the square of the diameter of the pipe. If, therefore, a weak fitting has to be relieved, the bend should be of the thinnest possible metal. Mr. Stromeyer prefers steel bends to copper ones, because having a higher elastic limit, they give a greater range of motion. If the pipes are arranged to be short, when cold, by half the designed range of the bend, then the value of this bend is practically doubled, and if the straight line of pipes can deflect sideways, the range is again doubled. A 4-ft copper bend is, under these circumstances, capable of relieving an expansion amounting to 1-6 inch.

ENGINEERS' AT-HOME.

The annual At-Home of Toronto No. 1, C.A.S.E. was held in St. George's Hall, Elm street, on February 24th. During the evening a musical programme was rendered by Mrs. Coutts-Bain, Mrs. Sears, Miss Coutts, Miss Froud and Messrs. Chas. Ellis, H. Gillogley, and W. G. Blackgrove. Dancing was kept up till an early hour to the strains of Prof. Hardy's orchestra. The At-Home committee comprised W. G. Blackgrove, chairman ; James Bannon, secretary ; H. E. Terry, N. V. Kulham, E. J. Philip, W. H. Johnston, J. W. Marr, R. J. Johnston, Alex. Stoner, and [illegible] Webb, president of the association.

Mr. Charles O. Card purposes building a flour mill at Cardeston, N.W.T., in which he will install an electric light plant.

WILLIAM HAMILTON.

Death has removed one of the prominent citizens of Peterborough, Ont., in the person of Mr. William Hamilton, the founder and for so many years the head of the William Hamilton Manufacturing Company, of that city. Ten years ago Mr. Hamilton was stricken with paralysis, and since that time was an invalid.

Mr. Hamilton was a Scotchman and was in his 79th year. In 1844 he came to Canada and worked as a machinist in Hamilton and Cobourg. Then he went to the United States and in 1850 established a foundry at Shelbyville, Ind. Leaving there in 1856, he went to Peterborough and established the works which have since grown to the large establishment conducted by the William Hamilton Manufacturing Company. By energy and business talent the business was made to grow and develop. At the present time it is one of the most progressive establishments in the manufacture of mining and mill machinery, water wheels, etc., the products of the works being in use in mills and factories from the Atlantic to the Pacific coast.

The late Mr. Hamilton, although often consulted, never sought any public position, but always took an active interest in the affairs of his town and country. He was a man of integrity, energy and preseverance, and gave close attention to the interests of the industry of which he was the head. He was most highly respected by his employees, as well as by all who knew him. Mrs. Hamilton, five daughters and one son survive, the latter being Mr. William Hamilton, president and general manager of the company.

TRADE NOTES.

The Goldie & McCulloch Company, of Galt, Ont., advise us that they are now putting the word "Canada," as well as "Ont.," on all their machines. That is to emphasize the fact that Canadian users of machinery do not need to import machines, and that Canada certainly has a place in the manufacturing world.

At a recent meeting of the directors of the Robb Engineering Company, Amherst, N. S., it was decided to issue a balance of $70,000 of debentures and $30,000 of stock held in the treasury. During the past year the company's sales increased considerably, and orders are now on hand to keep the works busy for the next six months, so that a further increase in the capacity of the plant seems necessary. Mr. John F. Stairs, president of the Nova Scotia Steel & Iron Company, and Mr. Grant, director of the Nova Scotia Building Society, were appointed to the directorate.

The Burridge Company, Winnipeg, agents for The Goldie & McCulloch Company, Galt, have recently sold a 100 horse power Wheelock engine, two 75 horse power boilers, with shafting, pulleys and hangers, to The Brandon Binder Twine Company, of Brandon, also an 8 x 10 Ideal engine to the Winnipeg General Hospital, which makes two of their Ideal engines now in use in this hospital. They have recently installed a 10 x 10 Ideal engine for the North-West Laundry Company, of Winnipeg, and have also wood-working machinery in transit for delivery. The Burridge Company has recently established themselves in Winnipeg, doing business principally for The Goldie & McCulloch Company, of Galt, and the Kerr Engine Works Company, Walkerville, Ont., manufacturers of steam and hydraulic valves.

When the fire occurred at the Royal Electric Station in Montreal and destroyed the wide double leather belts, it was thought that there would be much delay in obtaining new ones, but such was not the case for the reason that the enterprising firm of Sadler & Haworth had men upon the ground before the fire was out, removing the damaged belts to their factory to repair as best they could, so that they could be used the same night. It was discovered, however, that the large 54-inch, 3-ply belts, which were made by the same firm about 12 years ago, could only be repaired temporarily, and under the circumstances an order was given to Sadler & Haworth for new wide belts, including a number of smaller sizes, upon condition that they would be all ready within three days. To the surprise, relief and pleasure, however, of the manager of the Royal Electric Co., all the belts, including the large ones, were in position and ready to run, in 48 hours after order had been given, which goes to show that the firm of Sadler & Haworth have unusual facilities for handling large contracts in a short space of time. Had this not been the case, the city of Montreal would have been obliged to have resorted to some other method of obtaining light than from electric power.

MOONLIGHT SCHEDULE FOR APRIL.

Day of Month.	Light.		Extinguish.		No. of. Hours
		H. M.		H. M.	H. M.
1....	P. M.	7.00	P. M.	3.30	8 30
2 ...	"	7.00	"	4 00	9 00
3....	"	7.00	"	4.30	9.30
4....	"	7.00	"	5.00	10.00
5....	"	7.00	"	5.00	10.00
6....	"	7.00	"	5.00	10.00
7....	"	7.00	"	5.00	10.00
8. ..	"	7.00	"	5.00	10.00
9....	"	7.00	"	4.45	9.45
10....	"	7.00	"	4.45	9 45
11....	"	7.00	"	4.45	9.45
12....	"	7.00	"	4.45	9.45
13....	"	10.30	"	4.45	6.15
14....	"	11.30	"	4.30	5.00
15....	"	0.15	"	4.30	4.15
17 ...	"	1.00	"	4.30	3.30
18....	"	1.30	"	4.30	3.00
19...	"	2.00	"	4.30	2.30
20....	"	2.30	"	4.30	2.00
21....	No Light.		No Light.		....
22....	"		"		....
23....	A. M.	7.20	A. M.	9.20	2.00
24....	"	7.20	"	10.20	3.00
25....	"	7.20	"	11.00	3.40
26....	"	7.20	"	0.00	4.40
27....	"	7.30	"	0.40	5.10
28....	"	7.30	"	1.20	5.50
29....	"	7 30	"	2.00	6.30
30....	"	7.30	"	2.30	7.00
			Total		180.20

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1 60-light Royal Type Transformer, 1040 volts to 110 newly re-wound.
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PUBLICATIONS.

The second edition of Wiener's "Practical Calculation of Dynamo Electric Machines" has been issued by the Electrical World and Engineer, 120 Liberty street, New York. The book contains 750 pages, 390 illustrations, and 125 tables, and sells for $3.00. The dynamo calculations contained therein are based upon the practical data and tests of over two hundred of the best modern dynamos. Differing from the usual text-book methods, the present treatise gives practical information in the form of original tables and formulas derived from the results of practical machines of American as well as European make. Among new matter added to the second edition are sections of the calculation of multipolar, multiple circuit, and double-armature dynamos; the calculation of dynamotors and double-armature motors; dynamo specifications; and wire-winding data and remedies for sparking.

The Pittsburgh Transformer Company, of Pittsburgh, Pa., issue a number of publications which will be found of very general interest. A characteristic feature of these is found in the fact that the type K transformer (made by this company) is treated of in a detailed manner and illustrated in a way that is, unfortunately, rare amongst advertising literature. In catalogue C will be found complete descriptions of this company's product. The half-tone engravings bring out the design and construction of the transformer exceedingly clearly. Bulletin No. 1 summarizes much of the matter contained in catalogue C. Bulletin No. 4 is devoted to the use of oil in transformers, and gives the results of tests showing the effect of oil both on the cooling of the transformer as well as upon the breakdown strength of insulating materials. The three-wire system of secondary distribution is treated of in Bulletin No. 7, and in view of the increasing use of this system, the information regarding three-wire transformers contained therein should prove of interest. Bulletin No. 8, the latest publication of the company, points out the importance of durability in transformers. The point made is that a transformer of the highest electrical efficiency is not truly efficient unless its construction and design is such that expenses from burn-out is reduced to a minimum. The product of this company appears to be as well liked and familiar to the trade in Canada as in the United States, which is doubtless due not only to its merits, but also to the care which has been bestowed upon the printed matter devoted to its description.

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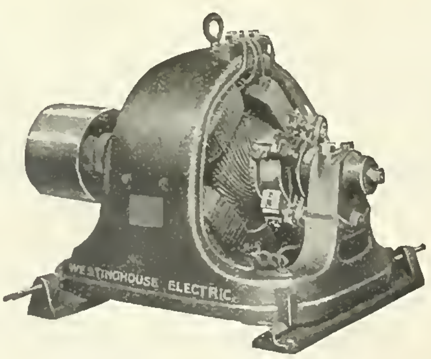

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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

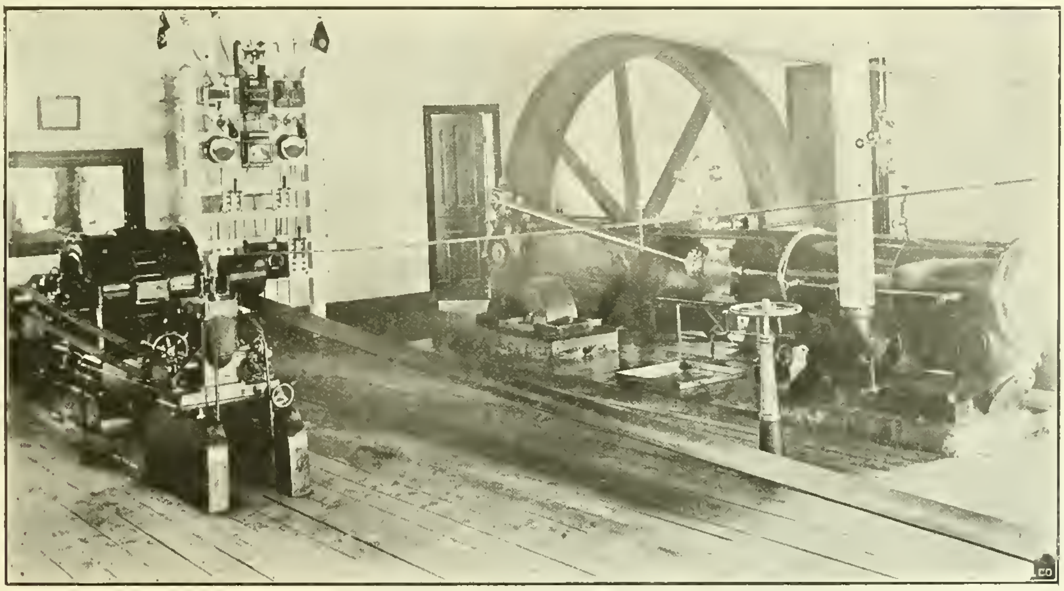
Vol. XII. APRIL, 1902 No 4.

THE NEW ELECTRIC LIGHT PLANT AT ALLISTON.

One of the finest and most complete plants of its size in Ontario is the new one of the Alliston Electric Light Company, which was completed last September.

Early in the spring of 1901 it was decided that some radical changes were necessary for the proper continuance of business, for the following reasons:

First, the steam plant was over-loaded, and being of an old type, expensive to operate. Second, the building was badly in need of repairs. Third, there was no capacity for handling any extension of the system.



Alliston Electric Light Plant—View of Engine.

Therefore an entirely new building was erected, and, with the exception of the electrical apparatus, which was comparatively new, was equipped with new and modern machinery.

The power house is a brick and stone structure 42 x 48 feet and situated about fifty yards immediately north of the old building. It was considered advisable to erect a new building, owing to the fact that the new machinery would necessitate extensive alterations to the old building, at a large expense, and even then it was not likely to be satisfactory. Again, in the new situation a much better rate of insurance is obtainable, also increased facilities for the development of a certain amount of water power, and ample yard room near by for the storing of the wood, which formerly had to be piled some distance from the plant.

The new building is laid out in a manner somewhat different from the average plant of this size, containing as it does an office for the superintendent 8 x 11 feet, a bed-room for the engineer 8 x 9 feet, a fire-proof oil and store-room 7 x 12 feet, beside the engine-room 27 x 38 feet, and the boiler-room 12½ x 40 feet. In the engine-room the allotment of floor space has been exceptionally liberal, and as a result the engineer has easy access to any bearing or any part of the machinery with perfect safety to himself, a feature which is often overlooked in many plants.

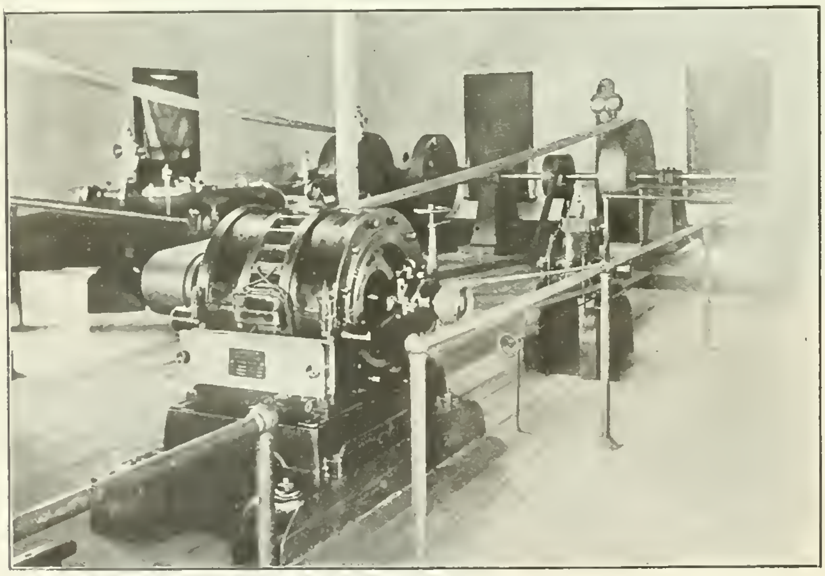
The steam plant was manufactured and installed by the Goldie & McCulloch Company, of Galt, and consists of one of their Wheelock engines, return tubular boiler, counter-shaft with complete equipment, belted jet condenser and duplex steam pump. The engine is of their latest type and is single cylinder condensing 14 x 34 inches, with fly wheel 11 feet 6 inches in diameter and 20 inch face. At 90 r. p. m. and using low pressure it is rated to give 125 h. p., but up to the present there has been no demand exceeding 100. It is expected, however, that in the near future considerably more than this will be required.

The counter-shaft is in three sections, of which two only are erected. It is mounted on iron stands of substantial and neat design, with self-oiling bearings. The first section is belted to the engine fly-wheel with a double ply endless leather belt, 18 inches wide, over a 42 inch drive. Immediately in front of this pulley is an adjustable tightener to give the belt sufficient contact and also take up any unnecessary slack. The second section contains the drive pulleys for the condenser and for the alternator, the latter pulley being 49 inches in diameter. These two sections are connected by a 27 inch Wilkinson clutch coupling. The third section, which will be belted to the water-wheel, will also be connected to the second by a similar coupling when the water-wheel is installed. This will likely be the coming summer.

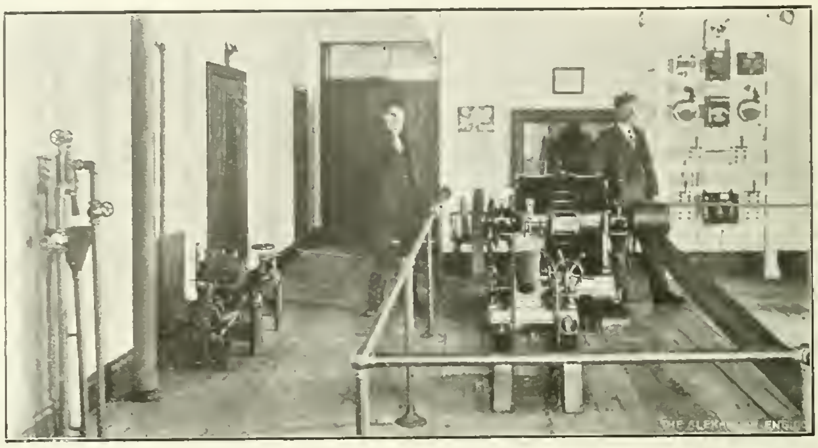
The water power is obtained from a dam on the Boyne river, which runs through the town of Alliston. An average head of about 16 feet is thus obtained. There is a 75 barrel flour mill, however, using what it requires, but at certain seasons of the year there is a great deal more than it can use, so by installing a wheel for the plant, a cheap power can thus be obtained for at least two months of the year, if not more, which would easily pay for the investment by the increased economy in running expenses.

The condenser is down cellar and is reached by an open stairway from the engine-room. The pump is 9 x 12 inches and has very little lift from the intake at the river—about four feet only—which means an easy supply of water. The discharge is piped to a hot well, built of brick and cement, with 13 inch walls and a capacity of about 500 gallons. The fact of this constant and ever-ready supply of water for fire buckets was a redeeming feature in the cost of insurance.

The boiler feed is a duplex steam pump 5¼ x 3½ x 6. The suction is piped to the hot well and also direct to the river, thus insuring a constant supply at all times. Besides the discharge to the boiler, there is also a valve and connection for hose, in case of fire. This feature effected another substantial reduction in insurance and combined with the hot-well, was the principal factor in reducing the former rate by about one dollar per hundred. In case of accident to the pump there is an auxiliary feed, in the form of a Penberthy injector of suitable capacity.


Alliston Electric Light Plant—View of Generator.

The boiler is a flush-front return tubular 63 x 14, with 84 three inch flues and tested to 180 lbs., giving a safe working pressure of 120 lbs. if desired. The smoke-stack is 76 feet high, 60 feet of iron, 28 inches in diameter, standing on a base of brick and stone 16 feet high, built on the side wall of the building, and connected with the boiler by a smoke pipe of the same size as the stack. In setting the boiler, the drawings, which called for 18 inch walls, were exceeded and a 22 inch wall substituted. From the way the boiler now holds steam when standing, it is thought that the increased expenditure was more than justified. It will be of interest to many to know that the new plant is now running all steam and driving much heavier loads with a fuel consumption of one-half cord wood less per night than was required by the old plant assisted by 40 h. p. of water through the greater part of the year.


Alliston Electric Light Plant—Exciter and Switchboard.

The old plant, by the way, consisted of a Killey automatic slide valve engine 14 x 22 and a return tubular boiler 60 x 13, on which a working pressure of 60 lbs. only was allowed by the Boiler Inspection and Insurance Company, so it will be seen that the contrast between the old and new is very marked.

The electrical equipment of the plant consists of a 60 k.w., type A., S. K. C. alternator, installed by the Royal Electric Company about three years ago, and an Edison bi-polar exciter of 1½ k. w. The switchboard is of wood, but being of neat design and painted, this is a feature easily overlooked. The lightning arresters are three in number, two of the Wurt's type and one of the S. K. C. The ammeters are of the round pattern, manufactured by the Royal Electric Company, while the voltmeter is square and of Canadian General Electric manufacture. The switches are four in number and are mounted on white marble bases. Two of them, double pole single throw, are on the main lines, while the other two, double pole, double throw, are on the voltmeter and street lighting circuit respectively. The rheostat is of the box type and is mounted on the face of the board. It will be noticed in the illustration that the lines leading outside from the board to the pole line are only connected in temporarily, on account of the ceiling not yet being finished.

For street lighting the alternating enclosed arc lamp is used, connected in multiple across the secondaries of a separate primary circuit, which is controlled from the switch-board. Light for two weeks in winter and for three weeks in summer is obtained from one trimming of the carbons, although the lamps are inspected and inner globes cleaned regularly once a week. On the incandescent circuit they are now driving in the neighborhood of 1000 lights, but it is expected to increase this number considerably during the year, having already added on over 100 lights since the completion of the plant.

Mr. W. J. Fletcher, who has for many years been associated with electric lighting at Alliston, is superintendent of the plant, and Mr. R. H. Martindale is the electrician in charge. To Mr. Fletcher is largely due the credit of the excellent general plan and layout of the building and the quality of the work done during construction, for he personally superintended all building operations. Taken altogether and in comparison with other places, Alliston has a plant of which its owners may be justly proud.

Alliston Electric Light Plant—Power House.

THE KINGSTON LIGHTING PLANT ARBITRATION.

Judge Lount has handed out his judgment on the motion of the Kingston Light, Heat and Power Company, of Kingston, Ont., against the award of the arbitrators appointed by the city and company. He has dismissed the motion with costs, holding that the company is not, under the agreement, entitled to be paid for its franchise—valued by the arbitrators at $80,000—nor that it is entitled to the 10 per cent. statutory addition to the value of the plant.

In July, 1896, the company contracted with the city to light the streets for a term of five years running from 1st January, 1897. Clause 13 of this agreement gave an option to the city to purchase the "works, plant, appliances and property" of the company at the end of the five years at a price to be fixed by arbitration. Clause 15 of the agreement provided that in the event of the "works, plant and property" of the company being purchased by the city, the company should cease to exist as a corporation and should surrender and set over to the city "all the rights, franchises, privileges and immunities."

The City Council decided to exercise the option to purchase the company's property and plant and gave the necessary notice. The arbitrators appointed were Judge McDougall, of Toronto, for the city, Judge Price for the company, Judge McTavish, of Ottawa, being the third appointed by the first too. All three arbitrators agreed in valuing the plant and property—that is the tangible assets—of the company at $170,373. All three arbitrators agreed in valuing the franchise of the company at $80,000. At this point, however, a difference of opinion arose as to the proper interpretation of the agreement. Judge McDougall and Judge McTavish held that the city never contracted to purchase the company's franchise at a price to be fixed by arbitration; but that when the city acquired the company's works and tangible property under clause 13 of the agreement, the company should under clause 15 cease to do business and should surrender its franchise to the city. On the other hand, Judge Price was of opinion that the city had contracted to buy the franchise at a price and should pay the $80,000 at which the franchise was valued. Judge Price was also of opinion that the city should pay the company the present value of 10 per cent. on the $170,373 as is provided by statute in the case of compulsory expropriation of gas and electric plants.

In the result the award meant that the city should pay $170,373 for the company's plant and property and nothing for the franchise. The company moved against this award and sought to have it amended by adding to the $170,373 the sum of $80,000 for franchise and also the present value of ten per cent. on the $170,373. This motion is by the judgment just delivered dismissed with costs, the city thus succeeding on all points.

MOONLIGHT SCHEDULE FOR MAY.

Day of Month.	Light.		Extinguish.		No. of Hours
		H.M.		H.M.	H.M.
1....	P.M.	7.30	P.M.	3.10	7.40
2....	″	7.30	″	3 40	8.10
3....	″	7.30	″	4.15	8.45
4....	″	7.30	″	4.15	8.45
5....	″	7.30	″	4.15	8.45
6....	″	7.30	″	4.15	8.45
7....	″	7.30	″	4.15	8.45
8. ..	″	7.30	″	4.15	8.45
9....	″	7.30	″	4.00	8.30
10....	″	7.30	″	4.00	8.30
11....	″	7.30	″	4.00	8.30
12....	″	10.15	″	4.00	5.45
13....	″	11.00	″	4.00	5.00
14....	″	11.30	″	4.00	4.30
16....	″	0.00	″	4.00	4.00
17 ...	″	0.30	″	4.00	3.30
18....	″	1.00	″	3.45	2.45
19....	″	1.30	″	3.45	2.15
20....	No Light.		No Light.		....
21....	″		″		....
22....	″		″		....
23....	A.M.	8.00	A.M.	10.00	2.00
24....	″	8.00	″	10.40	2.40
25....	″	8.00	″	11.20	3.20
26....	″	8.00	″	0.00	4.00
27....	″	8.00	″	0.30	4.30
28....	″	8 00	″	1.15	5.15
29....	″	8.00	″	1.45	5.45
30....	″	8.00	″	2.15	6.15
31....	″	8.00	″	2,45	6.45

Total............162.05

The Port Dover-Berlin Electric Railway Company has changed its name to the Grand Valley Traction Railway Company.

Mr. R. J. Wilson, manager of C. P. R. Telegraphs at Kingston, Ont., for the past fifteen years, has been appointed superintendent of the Oshawa Electric Railway.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Costs and Charges for Electric Light.

THE Electrical Review, of New York, has collected from electric lighting companies some valuable statistics regarding the cost of fuel, the rates charged for electric current, and the basis of charge. The highest price paid for coal is $6 per ton, and the lowest price $1 per ton, the latter representing slack coal and the former "run of mine." The average price is $2.96 per ton delivered at the plants. It would seem from the figures that the price of fuel is in many instances but a minor factor in determining the cost of electric current, inasmuch as in the Middle States, where the average cost of coal is $2.29 per ton, the base charge for power is 12 cents per kilowatt-hour, while in the Western States, where coal costs an average of $3.68 per ton, the average charge is only 7.5 cents per kilowatt-hour. If the figures are to be taken as correct, there are other elements than the cost of fuel which are of more importance in determining the charge to be made for current. The highest base rate of charge made anywhere is 20 cents per kilowatt-hour, this rate being confined to a few stations in the Eastern States. The average base charge, taking the entire country into consideration, is 12.3 cents per kilowatt-hour, while the average minimum charge to large consumers is 5.1 cents. The method of charging for current is now confined very largely to the meter system. The statistics show that 87 per cent of the supply stations use the meter basis exclusively, while only 9 per cent. adhere to the old contrast basis, and 4 per cent. use both the contract and meter basis.

Electric Power in Montreal

THE Shawinigan Water Power Company have officially announced that they will be prepared to deliver electric power in Montreal in September of this year. The contract for the transmission-line has been awarded, and we are told is to be carried to a speedy completion. The company are certainly exhibiting much confidence in the prospective demand for electric power in Montreal, where at this present time there does not appear to be a very promising opening for another company. It is hoped that they may not be doomed to disappointment. To say the least, the directors of the company are enterprising, as in the face of the defeat by the Quebec Legislature of a bill which was intended to give the company the necessary rights for the distribution of power in Montreal, it is proposed to proceed with the enterprise. It may be that their plans are being concealed, but unless privileges can be secured from some of the existing companies, it is difficult to see how they will be able to operate in Montreal. The antipathy which exists against the placing of more poles and wires in the streets, is believed to be too strong to admit of the privilege being granted to the Shawinigan Company. Possibly they are relying on underground construction as a final resort, but in such case the territory in which they could operate would be extremely limited. While there are doubtless some advantages in placing wires underground, such work must be considered as a business proposition. It is only in thickly populated districts that underground construction can be resorted to with profit. To construct one hundred feet of underground conduit for two and three-phase circuits costs, it is estimated, in the neighborhood of one thousand dollars. To cover this cost alone, therefore, a considerable sum must be realized from the sale of current to customers situated within that space. This sum is greater than can be obtained in outlying districts or in any district where there are not large users of current. True the cost of maintenance of underground conduits permits of a saving as compared with overhead work. Another point in connection with underground conduits is that the expediency of placing high and low potential wires in the same conduit has not yet been satisfactorily settled.

Electric Shocks.

Three papers on "Electric Shocks" were read at a recent meeting of the British Institution of Electrical Engineers. The papers and the discussion which followed, show that very different views are held as to the amount of current that will cause death, and that it depends very largely upon conditions. It was generally admitted that pressures below 600 volts are not liketo produce fatal results, while above 1000 volts the danger increases rapidly. Upon the resistance of a person depends to a large extent the result. If a person is in feeble health, death might be caused by a pressure of 500 volts. One speaker placed the resistance of a person at 60,000 ohms, but this was generally believed to be too high. The most valuable experiments regarding electric shocks were claimed to be those of Dr. Bleile, whose results were deduced from about one hundred and seventy experiments on dogs. With high alternating currents, arrest of respiration was the first thing required, and in these cases artificial respiration was successful. With low tension currents —120 volts and less—there was no effect on the respiratory organs, and the heart was thrown into a condition of contraction from which it did not recover, and artificial respiration was fruitless. It was found, however, that if within a given time, while the heart was in this state of contraction, a high tension current was passed through it, the heart would begin to beat, respiration would cease, but would be restored artificially. At the close of the meeting a number of persons presented themselves for tests, and it seemed to be agreed that what was required was some way of stimulating the heart of a person in suspended animation through electric shock.

Design of Electric Plants.

THE skill with which the engineer overcomes difficulties, incident to physical conditions is illustrated in the design of a transmission plant in Mexico, a description of which appears in a recent issue of the Electrical World. The available falls, five in number, were scattered over a considerable area and were located on two streams. The difficulty of constructing canals or flumes to bring the water to one central point of development rendered it advisable to build a small power house at each fall. This, of course, increased the attendance required as compared with a single large power house, and the cost of construction was also greater. While wooden flumes over ravines are used in this country, masonry aqueducts were in this case adopted. The generating units were of 225 kilowats, the periodicity 50 cycles, and the voltage 22,000. When required the whole system is worked in multiple with the utmost freedom, the entire nineteen generators being sometimes thrown together. In connection with the switch-board, fuses are placed between the generators and the bus-bars, the advantage of which is in preventing the switch-board from being destroyed in case of short circuits. Metal poles are used for the transmission line. A storage battery with a reversible rotary converter is a feature of the main sub-station. In the distribution of the current for lighting and power in the city of Mexico, a primary voltage of 2,600 is used, and part of the primary distribution is underground. The secondary distribution is a two-phase system worked at 240 volts for motors and with a fifth wire converting the lighting system into an ordinary alternating current three-wire system at 120 volts on a side.

Some lessons from New South Wales.

A gentleman who recently spent some time in visiting Canada after having lived many years in New South Wales, had some interesting things to say about that country. He describes it as a country of vast natural wealth. As evidence of its development he points to the fact that, although the population is only 800,000, the export trade amounts to £3,000,000 annually. He states that New South Wales appears to be the Mecca towards which political theorists and economists tend, and in consequence socialistic ideas prevail to a much larger degree than in Canada. For example, all railways, telegraph lines, and public works of every kind are managed directly by the government. Asked regarding the result of these conditions, his reply was that under the prevailing system the cost of public works is very much greater than would be the case under our system of constructing such works by contract. Another deplorable result is that a system of bribery and corruption universally prevails, and the standard of public morality has become impaired. Some years ago the government of New South Wales borrowed a large sum of money for the purpose of constructing a railway from one end of the country to the other, a distance of about 1,000 miles. This money, however, has never been used for the object for which it was borrowed, but has been diverted and frittered away on a great number of minor objects. Much of it no doubt has found its way into the pockets of the politicians. There is here food for reflection for the press of this country and those who are clamouring for the control by the government and the municipalities of all kinds of business enterprises.

THE LATE WILLIAM HAMILTON, of Peterborough, Ont.

QUESTIONS AND ANSWERS

"Subscriber," Windsor, writes: I am sending you a number of cards which I took from our Wheelock engine under different conditions. You will notice a little kink shortly after the cut-off, which I would like to know the real cause of. You will notice one card without it. I took over 20 diagrams in half a day and they all show the kink except one. Let me know what you think of the cards in general.

Ans.—You have not given sufficient data to enable us to give an intelligent answer, but we believe that the trouble is with your indicator. Sometimes a kink such as is shown is caused by the indicator being a little stiff; in other cases by vibration. On the whole the cards are very good.

"Reader," Smith's Falls: Please answer the following questions in the next issue of the Electrical News. I am operating a 10x10 high speed engine running at 362 r.p.m. The h.p. of this engine as given by the makers at 300, 325 and 350 r.p.m., steam pressure 80 lbs, is 48, 52 and 56 h.p. respectively. In calculating the h.p. I make it 116.80—where am I wrong? I find the area of the piston to be 78.54 sq. in., travel of piston for each rev. 20 in × 362 r.p.m. ÷ 12 = 603 × 78.54 = 47359 ÷ 33,000 = 1.43 h. p. the value of 1℔ steam. What is meant by M.E.P., I.H.P. and initial steam pressure? In changing from 1,000 to 2,000 volts primary, and where the primary of the present transformers are only wound for 1,000 V, would it only be necessary in order to make them work on 2,000 V. to double them up on the poles, and connect the primaries in series; the secondaries are wound for both 52 and 104 V.

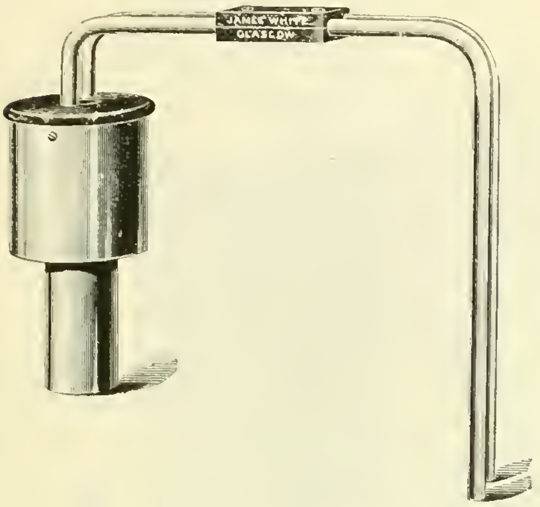
Ans.—Your error lies in the point that you used 80 lbs. the initial pressure, as the continuous pressure existing all the time in the cylinder, whereas you should use the average, or mean effective pressure, as it is usually termed. For 80 lbs. initial pressure, non-condensing, and cutting off about 1-5 stroke, this average will be about 35 lbs., somewhat less than half that supplied by the boiler. M.E. P. is the abbreviation of "Mean Effective Pressure, by which is meant the average or mean of the varying pressure in the cylinder during a stroke. At the start and up to the point of cut-off the full boiler pressure exists, from there onward it gradually decreases with the expansion until it reaches zero with the opening of the exhaust. The M.E.P. is the average of all these varying quantities which is effective for work on the piston during the whole stroke. I.H.P. is the abbreviation of "Indicated Horse Power" used to designate the horse power developed in the cylinder of an engine, as distinguished from the usual rating of horse power, which in most cases is taken to mean the output of the engine, after deducting the losses in itself, available for useful work. The initial steam pressure is the pressure of the steam at any instant up to the point of cut-off, as distinguished from the M.E.P. or the pressure at any given instant after the steam valve has closed. It is the same as the boiler pressure minus the losses in the piping. You can connect your transformers as you describe if care be taken to put their secondaries in parallel by means of leads of fairly large cross-section, no load being taken off them between the point where they join and either of the transformers. It is advisable to pair only those of the same make and the same size, and they should preferably be mounted on the same pole; if further apart it is a question if it would not pay you better to buy new transformers than to erect the various wires necessary. The proposition is not at all a simple one, and should be carefully considered before work is started.

"Student" asks: 1st. Is there any loss of current or electrical force in the mechanism of an open arc direct current series lamp, taking 9.6 amperes at 45 to 50 volts, and if so, how many watts are lost? If loss takes place it would seem that the last lamp in a series on a line would have much less force acting on it than the first lamps receiving the current from the station dynamo, a loss of force proportionate to the number of lamps on the circuit. 2nd. Where is the proper point to measure the voltage supplying an open arc direct current series lamp, is it where the current enters or is attached to the lamp, or is it in the arc itself? Is it possible to measure the voltage in the arc, and if so, how is it so measured. 3rd. Is there such a term as a true watt used in electrical parlance, and if so, what is the difference between a true watt and a plain ordinary watt.

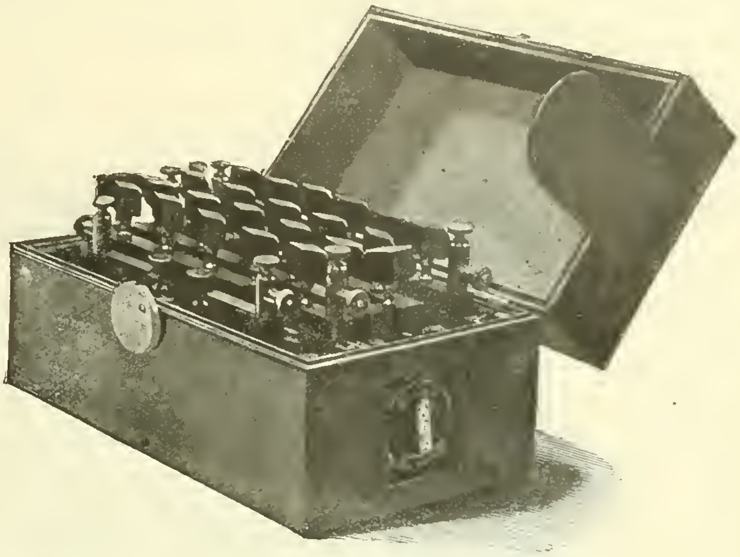
Ans.—1st. Strictly speaking, the only "loss" in a lamp such as you describe is the voltage drop due to the resistances of the various parts of the lamp through which the current has to pass. The lamp consumes 9.6x50 or 480 watts; part of this, 90 to 95 per cent. is used to produce useful light, which is the result sought, and therefore is not a loss; the balance consumed by the resistance, and manifesting itself in the shape of heat, which is not of any use, is a loss. The energy consumption of all the lamps in a circuit, presuming that their adjustments are similar, is the same for each one, though, as each lamp takes say 50 volts to operate it, there will be a steadily decreasing pressure all along the line until between the last lamp and the negative terminal of the dynamo there will be only 50 volts, while between the first lamp and the same terminal there will be, on a 50 lighter, 2,500 volts, at the second lamp 2,450, at the third 2,400, and so on. 2nd. It depends what you are measuring for, if you want to get the voltage of the complete lamp you would connect your meter across the lamp terminals, but if you desire to get the voltage of the arc only, the meter should be connected to the carbons or the carbon holders. 3rd. The term true watts is sometimes used, in alternating correct work, to distinguish that part of the current in a circuit which is in phase with the voltage from that part which is out of phase. To illustrate, a single phase machine may be carrying a load of 100 amperes at 1,200 volts, which gives an apparent kilowatt output, or as it is more often called, kilo volt amperage, (written for short kva), of 120. Now, if the power factor is 80%, the real kilo watts are 80% of 120, or 96, which is then said to be the true watts. The term is not found very often, the abbreviations kva and kw being now in general use to indicate, the first the apparent or volt amperes of the circuit, the second the true or actual watts. It of course follows that if the power factor is 100% or unity, the two are the same.

DOMINION GOVERNMENT ELECTRICAL STANDARDS.

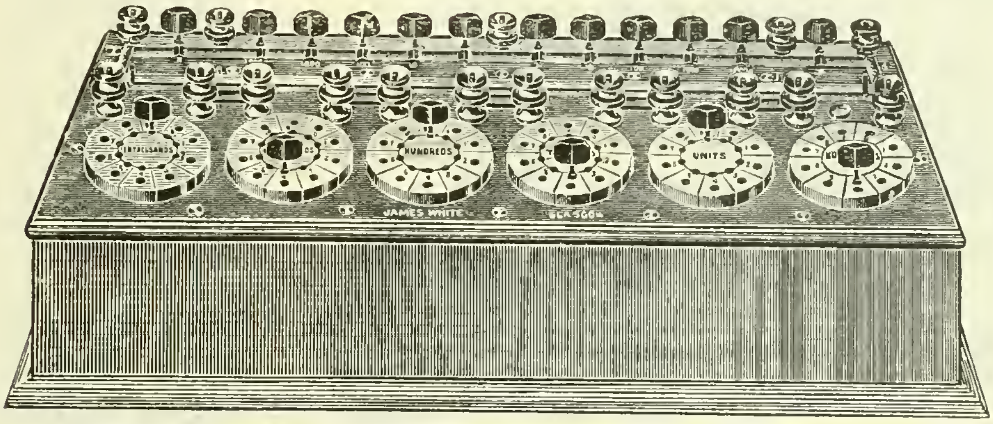
On the following pages will be found illustrations of the principal apparatus procured by the Inland Revenue Department at Ottawa as standards of electrical measure. These instruments have been selected by Mr. O. Higman, chief electrical engineer, and are in compliance with the requirements of the Electrical Units Act passed in 1894. A description of the different apparatus was given by Mr. Higman in a paper read before the Canadian Electrical Association in June, 1901, and published in the Electrical News for July of that year, to which the reader is referred.



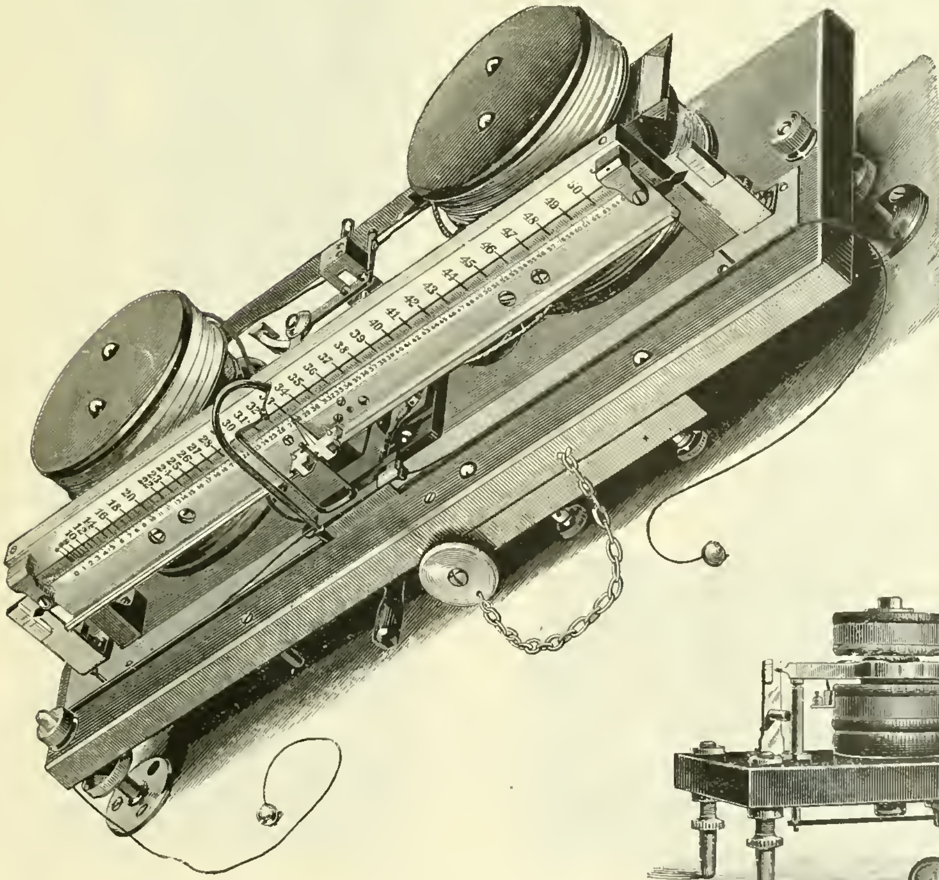
The Standard Ohm.



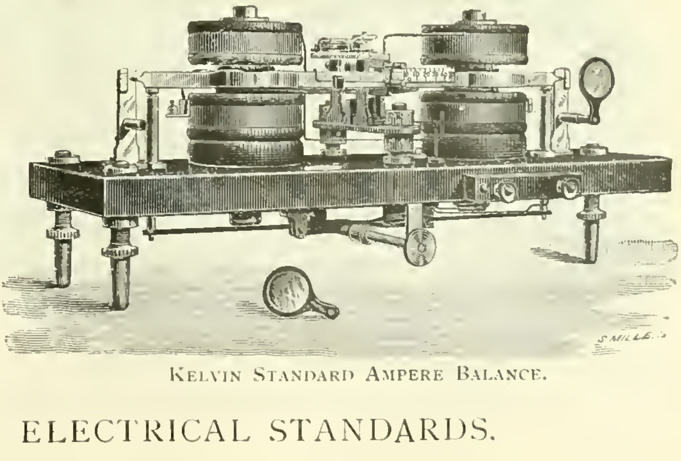
Standard Resistances—Multiples.



Wheatstone Bridge.

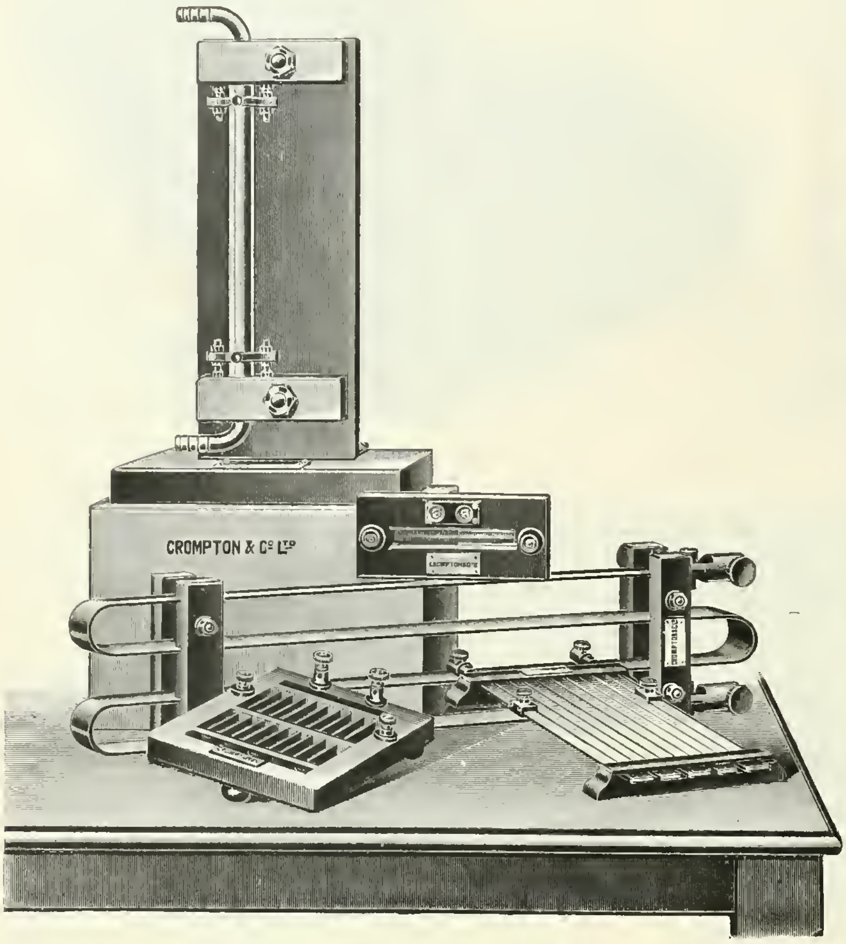


Kelvin Standard Centi-Ampere Balance.

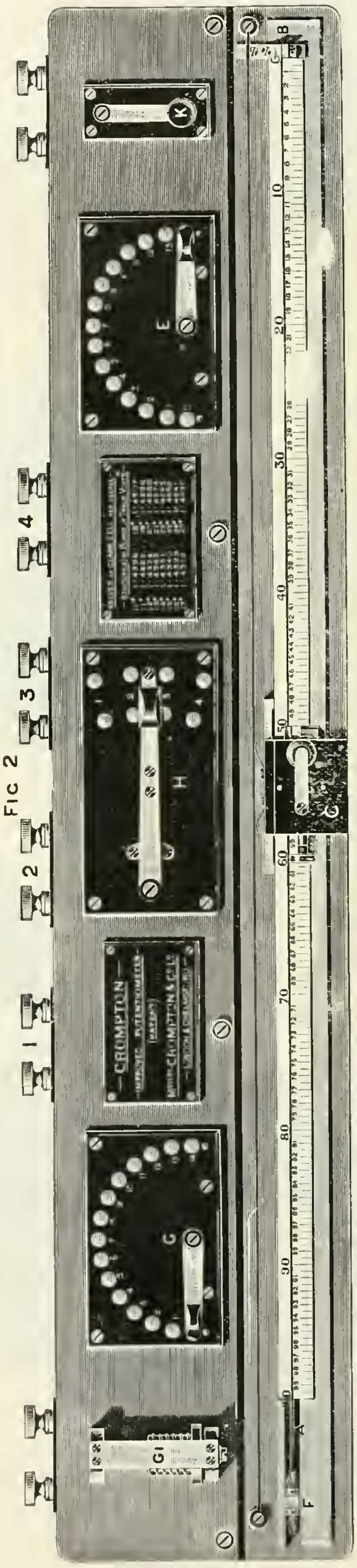


Kelvin Standard Ampere Balance.

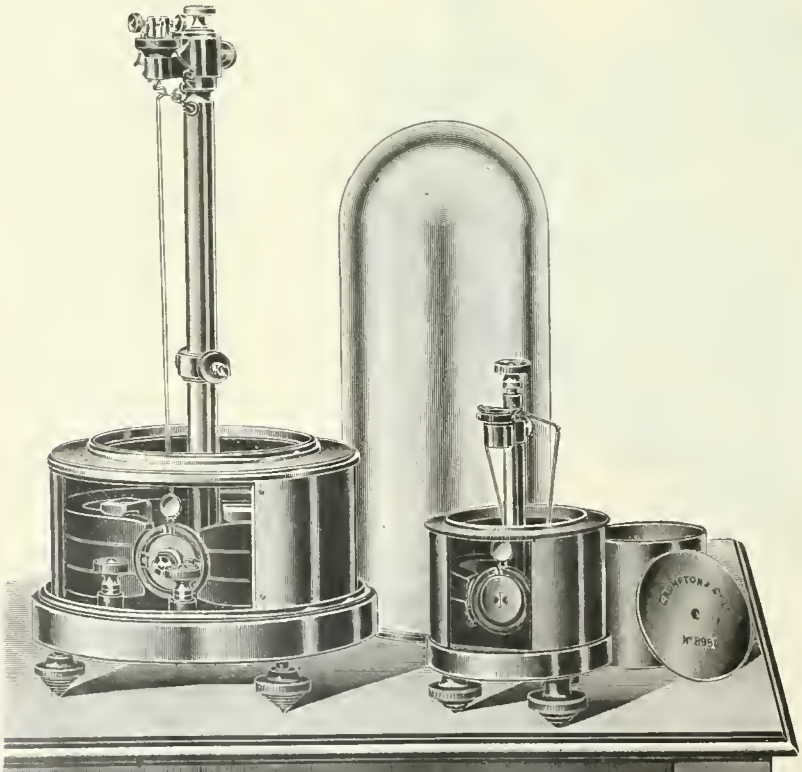
DOMINION GOVERNMENT ELECTRICAL STANDARDS.



Standard Resistances—Sub-Multiples.

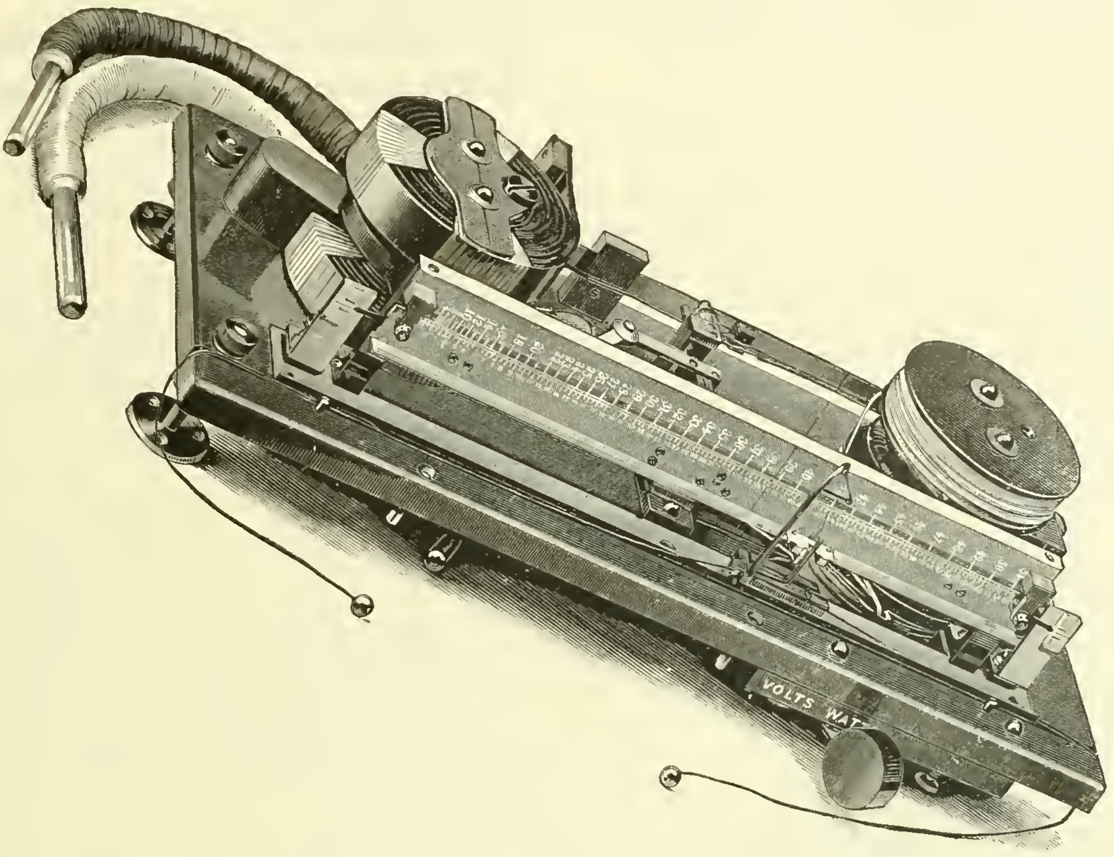


Crompton Potentiometer.

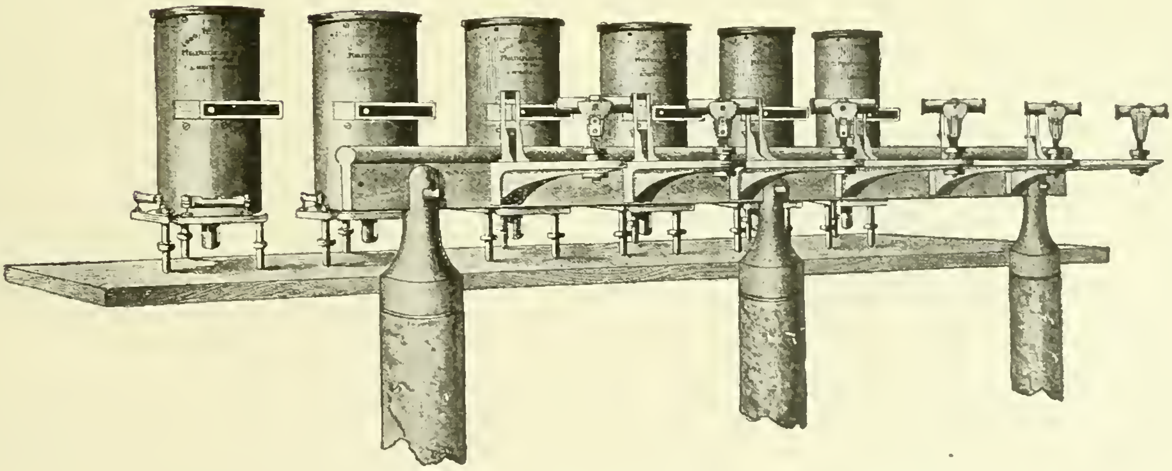


Standard High-Grade D'Arsouval Galvanometers.

DOMINION GOVERNMENT ELECTRICAL STANDARDS.



Kelvin Standard Composite Balance.



Kevlin Standard Electro Static, Multicellular Voltmeters.

DOMINION GOVERNMENT ELECTRICAL STANDARDS.

SCRANTON ENGINEERS' CLUB ELECT OFFICERS.

At the annual meeting, on January 23rd, 1902, of the Engineers' Club, Scranton, Pa., the following officers for the ensuing year were elected : President, H. H. Stoek ; vice-president, B. F. La Rue, professor of civil engineering in the International Correspnndence Schools; Secretary, A.E. Lister; Treasurer, F. J. Platt ; Corresponding Secretary, A. B. Dunning ; Librarian, H. M. Lane, Professor of Mechanical Engineering in the International Correspondence Scoools; Directors, W.M. Marple, C. C. Rose,and H.W. Rowley. President Stoek is the able editor of "Mines and Minerals," the well known mining publication issued by the International Textbook Company, Scranton, Pa., proprietors of the International Correspondence Schools.

SPARKS.

We are advised that the business of the Pittsburgh Transformer Company has reached such a volume during the past year, that the company has about completed arrangements to carry stocks of its Type K transformers in several of the principle cities of Canada. In the United States the company carries stocks in Philadelphia, Pittsburgh, Chicago, and San Francisco, from which prompt deliveries are made. The trade grows more and more impatient of delay in filling transformer orders, and the policy of the Pittsburgh Transformer Company directed towards making all shipments from stock on receipt of order has been highly appreciated by central station people.

The Washtenaw Electric Company, of Ypsilanti, Mich., using Pittsburgh transformers, recently reported an unusual case of overload carried by this make. Two ten kilo-watt transformers were carrying between them a store and opera-house load which on Saturday nights was very heavy. The fuse on one of the 10 kilo-watt transformers blew for some reason, and the remaining 10 kilo-watt transformer carried the combined load of both, from Saturday night until Wednesday night without burn-out. The oil transformer, of which the Pittsburgh Type K is a good example, possesses unusual ability to take care of overloads such as the above case, which is one of the reasons why oil has taken such a strong hold in transformer work.

CORRESPONDENCE

INSPECTION OF INTERIOR WIRING.

MONTREAL, March 28th, 1902.

Editor CANADIAN ELECTRICAL NEWS :

Dear Sir :—As an old subscriber, and as an electrician who has been many years connected with the "craft," the letter signed "Inspector" is full of interest. In the main his remarks are strictly in order, but he has to my mind not hit out from the shoulder sufficiently at those most in fault, viz., the Canadian Board of Fire Underwriters themselves. I take it that "Inspector" is a Montrealer, and that his remarks (as do mine) pertain to Montreal in particular. The Underwriters admit themselves in a late report, that nine-tenths of the fires caused have been by high tension," viz :—Ayer's Cold Storage, T. Paton, Guardian Building, etc. Now, as their regulations cover outside wiring as well as interior, why do they not make some attempt to control it, as they do the interior ? It is a well known fact that no matter how good an installation may be made for 110 volts, that not one in a thousand will not immediately be put "hors de combat" with 2,000 volts. No, instead of this they not long ago stamp their inspection reports that further inspection of the premises can be had from "the lighting company"; in fact allowing law breakers to be law makers and placing a reputable contractor at the diction of possibly a discharged employee who may have been taken up later by a lighting company as one of their inspectors. I do not say that such inspecters have shown any animus, but the loop-hole is open. Again, although as before mentioned an attempt (not very great) is made by underwriters at inspection of interior wiring for public and business buildings, yet no attempt whatever is made at same in private residences, although one of same might be right alongside of just such a public building, and by bad wiring cause a fire which might entail the loss of the public building in itself wired according to rule.

I venture to assert that there is not one secondary connection from transformer to building in the city of Montreal that comes strictly under the regulations. Further, sufficient discrimination is not used in feeding one or more residences from the same transformer. Often a residence lately wired is connected to the same main as one wired half a dozen years ago, thus bringing the good installation down to "par" with the bad. Underground wires, "high tension," would certainly cure some (not all) of the evils existing, but in all fairness to the lighting companies and to the customer who in the end pays the bill, no command for doing this immediately should be promulgated, but a convenient future date set at which time such conditions would be "un fait accompli."

By no means be it supposed that I believe interior wiring is all right. As 90 per cent. of the public accept the cheapest offer and as "Inspector" in his letter intimates, there are " tramp" wiremen irresponsible enough to accommodate that class. Interior wiring should be fully and compulsorily inspected, but as it is often and often made dangerous by outside conditions, the two should be inspected conjointly. How ?—by the underwriters having nothing to do with inspections further than paying one-half the salary of a competent and energetic inspector, the other half being paid by the city. This would prevent individual insurance companies over-riding underwriters, etc., as complained of by "Inspector." A last word regarding the "Press," whose scare headings "Inspector" also mentions : They may not be aware that their action has already begun to make some people quite nervous, and yet some of those very newspaper offices are subject to similar accidental conditions with their own wiring. They might also have the decency to use an equally heavy type for their disclaimer, as for instance, Lariviere's fire was heralded as electric in bold type, but when afterwards found to have been caused by a forge it was only deemed worthy of mention as unobtrusively as possible.

I do not wish to trespass further on your valuable space, but am quite willing to say "more anon" if necessary, as for instance on the cost of our present official inspections, the folly of asking certain risks to pay 25 cents per hundred extra, or get re-inspection every three months, etc.

Yours truly,

"JUSTICE FOR ALL."

Tenders are being taken by the Council of Cornwall, Ont., for lighting the town by arc and incandescent lights for periods of five and ten years.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,

MONTREAL, April 2nd, 1902.

Mr. George Thompson, electrician, formerly of Belleville, Ont., has joined the ranks of the Lachine hydraulic forces. Those who know George have found him " all right," and wish for him every success in his new sphere.

A visit to the R. E. T. Pringle Company's new ware-rooms presided over by Mr. Rough, the vice-president of the new company, would lead one to infer that they intend to do "the" trade of Canada, and Mr. Rough looks as if he meant it too.

Contractors report that after a slack month or two enquiries are now coming in rapidly and work is picking right up. Prospects for a lively spring are good.

The Canadian General Electric Company have sold a pair of 220 volt D. C. generators to Messrs. H. Lamontagne & Company for a light and power plant in the new factory, formerly the Balmoral hotel building. Construction is being done by the Montreal Electric Company.

We hear that Messrs. Fred Thomson & Company have secured orders from the Marconi Wireless Telegraph Company for the manufacture of some step-up transformers of a unique type for use in the C. B. transmitting station.

The electric installation at Shawinigan Falls for the new Belgo-Canadian Pulp Company was performed by the Montreal Electric Company, the specifications being by A. C. Rice, M. E., of Worcester, Mass.

The Electrical Workers Union claim to be increasing their membership steadily, and contemplate providing a course of instructive lectures in the course of a month or so which should benefit wiremen in general. They are also attempting to secure legislation to the effect that none but those having the necessary experience will be allowed to install electric light and power wiring—a consummation devoutly to be desired !

A Montreal street railway car ran away on Guy street the other day through a brake bolt giving way. The trolley came off, and the car sped straight across the G. T. R. tracks. Luckily, no train was coming, and no particular danger to property or life ensued. On a former occasion furthur up the same street a similar, though not altogether as fortunate an accident occurred about a year ago, and a Toronto correspondent wanted to know why motorman did not reverse connections and check speed of car by dynamo action. A little further enlightenment on this subject in the pages of the NEWS might prove of benefit, especially when it appears about one of the easiest things to do. Are our cars not equipped with that style of controller, or are motormen not advised of that point ?

Mr. David A. Starr, formerly general sales agent of the Royal Electric Company and late as a consulting electrical engineer on his own account, leaves Canada shortly to take a prominent position with the British Westinghouse Co. Mr. Starr's place of residence will probably be London. There are many friends, both business and private, who will be sorry that our genial friend is going away from our midst, but who at the same time wish him "every good luck".

It is said that a case will be brought on shortly by the Alliance Insurance Company, against the Royal Electric Company, to determine whether or not the latter are liable for the fire last year at the residence of Mr. Thos. Paton on Sherbrooke street, where high voltage entered on house wiring.

We have received a copy of the third edition of Bell's "Electrical Power Transmission." When the second edition of this work was issued in 1899 the longest transmission line in commercial use was eighty miles and the highest voltage forty thousand. To-day electrical energy is transmitted successfully over distances closely approximating two hundred miles and at pressures above fifty thousand volts. In the third edition the changes that have been taken place in the meantime in connection with electrical power transmission are clearly set forth. It is stated that the greatest changes have been in the direction of the more certain and efficient management of very high voltages. A brief chapter on commercial electrical measurements has been added to the book. The publishers are the Electrical World and Engineer, New York.

TELEGRAPH and TELEPHONE

EXPERIMENTS IN LONG-DISTANCE TELEPHONY.

With a view to giving the provinces the advantage of direct telephonic communication, experiments have been going on in the North of England. According to a statement in the London Electrical Engineer, during official tests by the Post Office authorities in Leeds, it was found possible to speak with Boulogne, a distance of about 300 miles. It is understood that this is the first occasion on which a telephone message has passed between any provincial town in the North of England and the Continent, with the exception of Liverpool, which was also recently the scene of similar experiments. In this case it was found possible to carry on a telephonic communication with Paris, the distance covered being about 500 miles. Further south than Paris, however, the speaker could only be heard in Liverpool under very favorable conditions. It is said that one result of these experiments has been the abandonment of the scheme to attempt telephonic connections between London, Turin and Milan, the opinion being that these cities are too far apart to be embraced in a telephone circuit. It is to be noted, however, that the distance one can speak with the telephone largely depends on the wires through which the message has to be transmitted, and that the non-success of the authorities to obtain a satisfactory connection with the telephone between Liverpool and towns south of Paris only applies to the particular circuits on which the experiments were made. With heavier copper wires conversations have been successfully held over much longer distances.

THE TELEPHONE.

It is hardly possible to realize that only twenty-five years ago the telephone was hardly more than the dream of two or three imaginative scientists, and that it was not until at least a decade later that this means of communication began to play an important part in the daily life of a considerable fraction of the earth's inhabitants. There are still not a few million human beings who have never used or even heard of a telephone, says Telephony, but they are the millions who count for little except in their own somewhat mistaken estimations. For all the really active and effectual part of humanity the telephone has come to be something not much different from a necessity of life. Social and commercial acttivities have so adjusted themselves to the machine which gives indefinite extension to ear and tongue that were the facility, not long ago unthought of, to be suddenly withdrawn, the most serious embarrassments would follow. The efficiency of every business man would be so materially decreased that for a while at least there would be grave trouble and confusion. Yet people have already come to use the telephone without a thought of what a marvellous thing it is, and we hear vastly more about the cost and imperfections of the service than about the numberless and inestimable advantages derived from it.

TELEPHONE DECISION.

Mr. Justice Street delivered judgment last month in the case of the city of Toronto against the Bell Telephone Company. The city, in effect, claimed that the company in its local business was subject to provincial legislation, and under that legislation could not use the streets except by consent of the municipality. The judge upheld this contention, and said the proper construction of these acts treat the Ontario act as conferring special rights upon the defendants in regard to their works in that province, and at the same time subjecting them to the necessity of obtaining the consent of the local municipalities to the use of the streets, while leaving to their act of incorporation its full operation in other provinces. It was declared that the defendants have no right to carry any poles or any wires along any streets of the city of Toronto without first obtaining the consent of the municipal council, but inasmuch as the Ontario act does not make their power to carry wires across streets dependent upon the previous consent of the council, they may carry them across the streets.

There was in existence a statute of the Ontario Legislature restricting the powers of the company in these terms: "In towns and cities and in incorporated villages [the company] shall not erect any pole higher than forty feet above the surface of the street, nor carry any such poles or wires along any street without the consent of the municipal council having jurisdiction over the streets of the said city, town or incorporated village."

SEEING BY TELEPHONE.

A dispatch from Paris of December 18th, says: Dr. Sylvestre, the inventor who claims to have discovered how to see by telephone, has just described his remarkable discovery, which he declares was a matter of chance. He said: "There is no reason why as soon as telephonic cables are established between Paris and New York, we should not see our friends there as easily as I see you. I have already seen the Marseilles Telephone Exchange from this room by means of my apparatus, and I have chatted by telephone with M. Mougeot, the French Postmaster General, watched his astonishment and described his appearance, his clothes, his office as we talked." The dispatch continues: "Dr. Sylvestre showed a small circular mirror, with a hole in the centre, into which is screwed a tiny electric light of 1-10th candle power. This is fixed to a telephone's microphonic plate by an India rubber band, a pencil-like instrument connecting the current with the apparatus. Two acids are allowed to mix, drop by drop, in a torpedo-like machine, about 3 inches long. This process throws what Dr. Sylvestre terms a phosphorescent flame on the looking glass connected with the poles, and pencil and a sheet of any white, semi-transparent tissue, placed before the glass, shows the room in which the other person is telephoning no matter how many miles away that person may be.

SHORT CIRCUITS.

Why should the C.P.R. telegraphers demand more pay? Don't they live on tick?—Toronto Star.

It is understood that a company is being formed to construct a telephone line from Woodville to Glenarm, Ont.

It is stated that Signor Marconi has decided to locate his wireless telegraphy station at Table Head, Glace Bay, N. S.

The business men and fruit growers in tne vicinity of Stoney Creek, Ont., intend forming a company for the purpose of constructing a local telephone system. Mr. J. B. Davis is secretary pro tem.

The annual meeting of the Valley Telephone Company was held at Middleton, N. S., on February 13th, at which the old board of directors was re-elected. The capital stock of the company has been increased to $100,000.

The Dominion Government has taken tenders for the construction of telegraph lines from St. Peter's to Main a Dieu, and on Scatari Island, a distance of 90 miles, also from Graberus to North Sydney, Cape Breton, a distance of 35 miles.

The Nova Scotia Telephone Company has elected officers as follows: President, B. W. Chapman; vice-president, R. Uniacke; secretary-treasurer, T. N. Goudge; directors, C. F. Fraser, B. F. Pearson, R. L. Borden, M. P., Dr. A. C. Cogswell, and C. F. Sise. J. H. Wingfield has been appointed general manager to succeed the late C. E. Harris.

Mr. R. T. Hamilton, manager of the Owen Sound branch of the Bell Telephone Company, has been promoted to the position of assistant district manager, with headquarters at Guelph. He has been succeeded at Owen Sound by Mr. Karl Wildren, of London, who was presented before taking his departure with a gold watch by the staff of the London office.

The Union Telegraph Company is seeking a charter from the New Brunswick government. It is an amalgamation of the telephone lines owned by Dr. Ross, of Florenceville, and Dr. Brown, of Centreville, which cover about 200 miles of wire and about 100 offices. The main branch line extends from Woodstock to the county border at River du Chute, but the intention is to extend it to Edmundston.

The engineers and apprentices of the Westinghouse Electric & Manufacturing Company, of Pittsburg, Penn., have recently organized the "Electric Club," for the purpose of closer union and co-operation. Comfortable and commodious quarters have been secured for the Club at 735 Penn Ave., Wilkinsburg, Penn These quarters include a lecture hall, reading, recreation and class rooms. The club is supported by the dues of the members, supplemented by a subscription from the company. The organization starts out with a membership of about three hundred.

ENGINEERING and MECHANICS

THE MANUFACTURE OF IRON.

Mr. Chas Fox, superintendent of the Hamilton Steel and Iron Company, read a very interesting and instructive paper on "The Manufacture of Iron" before the Canadian Association of Stationary Engineers, Hamilton, on Thursday evening, March 13th. Mr Robt. C. Pettigrew, past president, was chairman, and the meeting was attended by representatives of the Board of Trade, the Hamilton Scientific Association and members of the Canadian Club. Mr. Charles Moseley, executive president, paid his official visit at this meeting.

Mr. Fox spoke as follows:

"The term iron as used in a general sense includes all those products obtained originally from iron ore by smelting with fuel. Under the general term iron we have pig iron, which is iron made from ores in a blast furnace and cast in the form of pigs. The fuel used may be coke, charcoal, anthracite coal, or mixtures of these, and the pig iron named according to the fuel used in smelting, as coke pig, charcoal pig or anthracite pig. Then under each of these are other classifications according to the purpose the pig is applied to, namely, basic, bessemer, foundry, malleable and mill. This mill iron is put in a pudding furnace and all the impurities, such as carbon, sulphur, etc., are worked out of it, and we have wrot iron. Sometimes wrot iron is made direct from ore without first making pig iron. This is really the process by which iron was first made. It takes a very high temperature to melt wrot iron, but it may readily be brought to a welding heat in a heating furnace and then rolled into bars. A peculiarity of wrot iron is the fibre; when broken it presents a fracture like wood. A piece of steel in breaking shows no such fibre, only a clear uniform break. The wrot iron has slag disseminated all through it and when rolled out these lines of slag break the continuity of the metal and make the fibre.

Coming now to pig iron and the blast furnace, if we had merely to melt the iron as in a cupola, its operation would be comparatively simple, it being only necessary to maintain the proper temperature. To take oxygen away from iron and silicon away from oxygen heat is not enough; we must have the combined action of white hot carbon and heat of special intensity. In a furnace working regularly the temperature is highest at tuyeres and gradually decreases to the throat. When the temperature becomes too high in the upper part of the furnace the partly reduced oxides in coming in contact with the silicon of the gangue, may form a fusable silicate and pass into the hearth unreduced, making scouring cinder. If temperature at zone of fusion is low, the amount of silica reduced will be small and the slag on account of this excess will be too fusible, and the iron, not being retained long enough at high temperature, will become carbonized and an inferior grade of iron is the result.

Several causes may produce improper distribution of heat in the furnace. The affinity of carbon for oxygen is greatest at high temperature; when temperature of blast is raised, the zone of combustion contracts. Now, if the initial temperature of the air is lowered, the zone widens and the heat gets higher up in the furnace, causing fusion above and bad working. The condition of the blast is one of the principal factors in determining the working of a furnace. The temperature must first be considered, then the amount of moisture it contains. Water has to be decomposed by coke.

Ore is reduced mainly in the upper part of the furnace by the ascending gas. The impurities in the ore and stone combine to form slag. Refractory slag requires high temperature for its formation and partly reduced iron will be exposed a long time to the intense heat of the tuyeres before passing into the liquid state at the bottom of the hearth. Only slag from charcoal furnaces have potash or soda—these are very powerful in removing sulphur, making it possible to make charcoal iron free of sulphur with acid slag. Consequently the lower the carbon, the stronger the iron.

All foundry iron was formerly graded by fracture and color. This was done as carefully as possible, but it is a difficult matter to draw the line between a close No. 1 and an open No. 2. No matter how carefully grading by fracture and color is done, there must, by the very nature of things, be in every grade some pigs closer than others, and even if the grading is well done the fracture is no reliable indication of what the iron contains, all that can be deduced from the fracture of iron is that open grained iron is generally low in sulphur, and close grained is high. Careful chemical analysis is the only trustworthy means of finding out what an iron contains.

Silicon is the best known of all constituents of pig iron. It increases the fusibility of iron, lessens the formation of blow holes and reduces the chances of shrinkage. The strongest castings are obtained from iron that will produce sound castings with the least amount of silicon. Pig iron with excessive silicon has characteristic fracture, the grain is often close and flat and the color light. The most important action of silicon in iron is to convert combined or hardening carbon into graphitic or softening carbon.

Carbon exerts the most vital influences upon the character of pig iron. It affects the color, strength, hardness and fusibility of cast iron. In two distinct forms, the combined and the graphite, and upon the relative proportions of each, in a great measure depends the character of the metal.

The tendency of phosphorus is to prevent blow holes and render the metal very limpid so that it will give an extremely fine and sharp casting. The percentage of phosphorus varies in pig iron from a trace to several per cent.

Manganese assists in the prevention of blow holes. It has a great affinity for sulphur. When iron is melted with fuel containing a high percentage of sulphur the manganese seizes upon the sulphur and carries it off with the slag. It also strengthens the castings.

Sulphur is without doubt the most deleterious substance found in pig iron. It makes iron red-short, that is brittle when hot, also hard and white, sluggish and thick, causing blow holes during its solidification. Limestone is generally used for removing sulphur.

Coke for foundry use should be of the highest grade obtainable because the impurities in the coke are taken up to a very large extent by the iron in melting. Good coke has a bright lustre and a metallic ring; it should be strong and light and low in sulphur. The only accurate way to determine the amount of sulphur in coke is to have it analyzed by a reputable chemist.

Into a blast furnace making from 3,000 to 4,000 tons of iron a day must be blown 33,000 feet (cubic) of air per minute and to do this it will probably require 350 tons of coke, and 2,000 horse power will be necessary."

Samples of Canadian ore and foundry pig iron were shown and the speaker's remarks illustrated by means of a blue print of a blast furnace and sectional drawing of a stove.

At the conclusion of the paper a vote of thanks was moved by Mr. J. G. Cloke and seconded by Mr. Geo. Black. In a few well-chosen words the chairman presented the thanks of all present to Mr. Fox, who briefly acknowledged the same.

BANQUET OF HAMILTON No. 2.

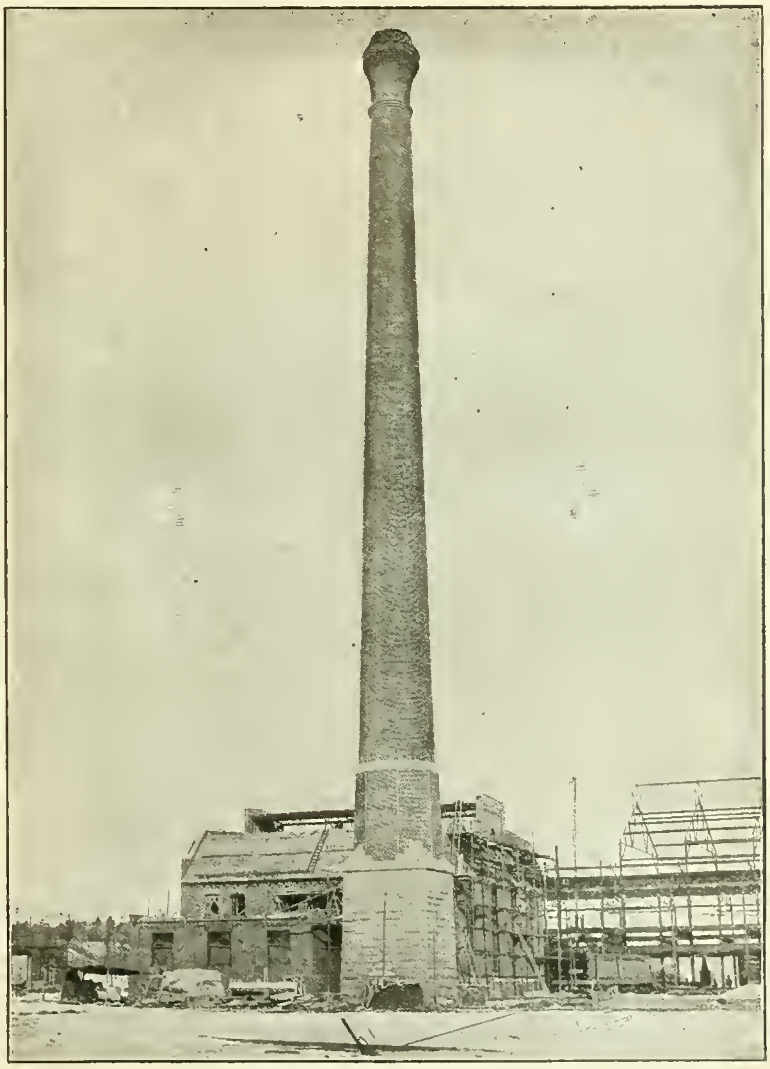
The annual banquet of Hamilton No 2, Canadian Association of Stationary Engineers, was held at the Commercial Hotel in that city on March 27th. There was present a large party of engineers and their friends, who were entertained by an excellent luncheon, music and speech making. The toasts and respondents were as follows: "The King," by singing the National Anthem; "Canada Our Home," H. Carscallen, M.P.P.; "Hamilton the Ambitious City," by Ex-Ald. James Donald; "Manufacturers," by I. C. Eby; "Educational Interests," by S. J. Ireland, principal School of Art and Technology; "The Executive Head," by Charles Moseley and A. M. Wickens, Toronto; "Kindred Associations," by Thomas Elliott, Hamilton, W. J. Webb and James Huggett, Toronto. Those contributing to the musical programme were J. H. Allen, pianist, James Jardine, Walter Hyslop, W. Golden, Samuel Blakely and N. B. Kitchen. The banquet committee consisted of W. R. Cornish, chairman, S. J. Sculthrop, James Ferguson, J. Ironside, R. C. Pettigrew, W. Stevens, Thomas Chubb and D. Hunter.

A FINE CHIMNEY.

The Canada Foundry Company, Limited, are rapidly bringing to completion a mammoth manufacturing plant situated at the head of Mackenzie avenue, at the crossing of the C. P. R. and G. T. R. systems, in Toronto. The property consists of thirty-two acres, and the buildings at present under construction are : Machine shop, foundry, structural iron works, blacksmith shop, power house, and pattern vault. To these will shortly be added an engineering and draughting building and pipe foundry. The buildings are all fire proof, being constructed of concrete, brick and steel. The pattern vault is also provided with non-breakable glass windows set in metallic sashes, capable of resisting any fire.

The accompanying cut shows the recently completed chimney, a magnificent piece of work standing 216 feet above the foundations. At the base is situated the power house, in which will be installed a large battery of boilers, steam engines, electric generators, etc. The motive power generally used throughout the building will be electricity, but hydraulic and compressed air lifts will be utilized for chipping, riveting, caulking, etc. Each building will be supplied with electric cranes and individual compressed air lifts will be installed wherever necessary.

The Canada Foundry Company, Limited, is controlled by the Canadian General Electric Co., Limited.



Chimmey at Works of Canada Foundry Company, Toronto.

LEGAL DECISIONS.

A favorable decision to the city of Ottawa has been rendered in the suit brought by the Ottawa Electric Company to prevent the city from imposing a fine for lights out. The company sought to recover $18,669.30 balance alleged to be due under a contract for lighting the streets of Ottawa. The city paid $12,485.15, and put in a counter claim for 4,482.13, being the amount of fines imposed for lights out after the big fire of April 26th, 1900. The judge held that the electric company was entitled to recover the contract price of $65 a year, less a deduction for lights out or not kept lighted when they should have been. It was held to be obligatory on the company to pay the penalty for lamps not lighted whether the cause of default be unforeseen accident or otherwise.

Hull Electric Company vs. Ottawa Electric Company.—The appeal of the first named company was dismissed by the Privy Council. The concluding clause of the judgment, which puts the main points at issue in a nutshell, is as follows :

"Their lordships think that the real meaning of the transaction was this : The city of Hull granted to Viau an exclusive right of establishing a system of electric lighting for a certain term of years, that is to say, by their grant to him they bound themselves during the period not to grant such a right to anybody else ; but at the same time they said to Viau : " You must remember that we have granted permission to the Ottawa company to establish a system of electric lighting in the city of Hull and that system is now in operation ; we bind ourselves not to convert that permission into a right, but we do not bind ourselves to revoke that permission at your bidding. We keep the power of revocation in our hands." Possibly the consideration that the Ottawa company was to be left to carry on its operations in Hull until the council saw fit to revoke its license may account for the singular fact that in passing by-law number 61, the council did not think it necessary either to impose on Viau and his associates any obligation to furnish a supply of electric light to the municipality or to those of the inhabitants who might require it, or to place any restriction upon the charges which Viau and his associates might demand. In the result, therefore, their lordships agree in substance with the second ground of the decision of the Court of Queen's bench, and they will humbly advise His Majesty that this appeal ought to be dismissed. From this judgment it appears that the Ottawa company have been given no rights in Hull, though they have been granted permission to establish there by the council and can be forced to move when the council decides. But at the same time it holds that the Hull Electric Company cannot on its motion force the other company to leave the city. Though several parts of the Quebec judgments in favor of the Hull company were reversed, the costs of the appeal will have to be borne by the Ottawa company, inasmuch as the latter's contention that they had the right to force the Hull company to leave the city was not maintained.

OIL AND COAL TESTS.

Tests of the relative efficiency of coal and oil as fuels have been made at the plant of the Dallas Electric Co., Dallas, Tex. As a result of these the following figures have been presented by J. E. Ludlow :

Tests made with mine-run McAlester coal at the Dallas Electric Co.'s plant, on Aug. 5, under boiler of rated capacity of 370 horse-power, based on ten square feet of heating surface; duration of test eight hours, from 8.30 a. m. to 3.30 p. m. :

Coal consumed, 10,000 pounds.
Cost of coal per ton of 2,000 pounds, delivered in plant, $3.15.
Water evaporated, 75,973 pounds.
Water evaporated per pound of coal, 7.59 pounds.
Temperature of feed water, 90 degrees.
Evaporated from and at 212 degrees, 8.87 pounds.
Steam pressure, 110 pounds.
Factor of evaporation, 1.169.
Cost of coal to evaporate 75,973 pounds of water, $15.75.

Evaporation test of Beaumant crude oil at the Dallas Electric Co.'s plant, under boiler of rated capacity of 370 horse-power, based on ten square feet of heating surface, using one burner, duration of test eight hours, from 10.25 a.m. to 6.25 p.m., Aug. 17 :

Oil consumed, 6447.5 pounds.
Weight of oil per gallon, 7.43.
Water evaporated, 75,985 pounds.
Water evaporated per pound of oil, 11.78.
Temperature of feed water, 90 degrees.
Steam pressure, 110 pounds.
Factor of evaporation, 11.69.
Evaporated from and at 212 degrees, 13.77.

Cost of oil to evaporate 75,985 pounds of water at 59 cents per barrel of 42 gallons, $12.19.

ON GROUNDS FOR LIGHTNING ARRESTERS.*

Great importance must always be attached to the making of proper ground connections for lightning arresters, which should be as short and straight as possible from the arrester to ground. It is obvious that a poor ground connection will render ineffective every effort made with choke coils and lightning arresters to drive the static electricity into the earth, and it is, therefore, important not only to construct a good ground connection, but also to appreciate thoroughly the necessity of avoiding unfavorable natural conditions.

A good ground connection for a bank of station arresters may be made in the following manner: First, dig a hole six feet square directly under the arrester until permanently damp earth has been reached ; second, cover the bottom of this hole with two feet of crushed charcoal (about pea size); third, over this lay 25 square feet of No. 16 tinned copper plate ; fourth, solder the ground wire, preferably No. 0 copper, securely across the entire surface of the ground plate; fifth, cover the ground plate with two feet of crushed charcoal; and sixth, fill the hole with earth, using running water to settle.

The above method of making a ground connection is simple, and has been found to give excellent results, and yet, if not made in proper soil, it will prove of little value. Where a mountain stream is conveniently near it is not uncommon to throw the ground plate into the bed of the stream. This, however, makes a poor ground connection, owing to the high resistance of the pure water and the rocky bottom of the stream. Clay, even when wet, rock, sand, gravel, dry earth and pure water are not suitable materials in which to bury the ground plate of a bank of lightning arresters. Rich soil is the best. It is therefore advisable, before installing a bank of choke coils and lightning arresters, to select the best possible site for the lightning arrester installation, with reference to a good ground connection. This may often be at some little distance from the station, in which case it is, of course, necessary to construct a lightning arrester house. Where permanent dampness cannot be reached it is recommended that water be supplied to the ground through a pipe from some convenient source.

When possible a direct connection to an underground pipe system especially of town or city water main furnishes a very excellent ground on account of the great surface in contact with the earth and the numerous alternative paths for the discharge. In a water-power plant the ground should always include a connection to the pipe line or penstock. Furthermore, as the effectiveness of the arrester is of great importance it should be inspected from time to time, and the resistances and earth connection tested for open circuit.

VOLTAGE TESTS.

In view of complaints from different parts of the country with reference to the inadequate electric pressure supplied to incandescant lamps, the Department of Inland Revenue has called the attention of inspectors of electric light to the necessity for a more strict compliance, on the part of electric lighting companies, with the provisions of sec. 4 of the Electric Light Inspection Act. Inspectors are requested to make weekly tests of voltage in different parts of the cities or towns in which they reside, and as often as convenient in other parts of their districts. When the variation in voltage is found to exceed the limit allowed by law, the inspectors are to notify the contractors, in writing, of the fact, and request that the requirements of the Act be complied with.

For these weekly voltage tests the plugging on of the volt meter to lamp sockets at different points of the system will suffice ; but when formal demands for voltage tests are made by either of the parties concerned, the instructions given in the regulations must be followed. A report of the weekly voltage tests must accompany the monthly returns.

DEPRECIATION.

Business concerns, from the most modest shop to the largest railway and steamship companies, have gone into the hands of receivers from either the entire absence of, or improperly handled, depreciation account. That the subject is an intricate one, says Mr. L. S. Randolph in "Cassier's Magazine," can be readily shown by asking any given set of men what rate of depreciation should be allowed on a dynamo. One large steel works not long since built an enormous steel hammer. Three years later it was standing idle, being thrown out by the hydraulic press ; depreciation 30 per cent., the usual allowance being 3 per cent. Machines which ten years ago were the best on the market are superseded by those which will permit a competitor to double his output with half the labor ; the result is that the new machines must be purchased or the business abandoned. The whole list of the various elements of cost can be gone over in the same way and with the same result.

ELECTRIC RAILWAY CHARTERS.

At the recent session of the Ontario Legislature, the following companies obtained charters for the construction of electric roads : Durham Switch-Line Railway Company ; Huron and Bruce Railway Company ; Huron, Bruce and Grey Electric Railway Company ; Middlesex and Elgin Interurban Railway Company ; Morrisburg Electric Railway Company ; Ontario Electric Railway Company ; Peterborough Radial Railway Company ; Petrolea Railway Company ; South-Western Traction Company.

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*Abstract of a paper read before the American Institute of Electrical Engineers.

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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XII. MAY, 1902 No 5.

MR. J. C. M. BUNTZEN.

We introduce to our readers this month a gentleman whose attainments have placed him in the front rank among the managers of Canadian electrical companies. In Mr. J. C. M. Buntzen the British Columbia Electric Company have a manager of exceptional ability and energy, and one whose work has produced excellent results.

Mr. Buntzen was born at Copenhagen, Denmark, on December 16, 1859, and after completing a legal and mercantile education in Denmark, England and Canada, he became, in 1893, business manager of the Vancouver Electric Railway & Lighting Company. Two years later he was appointed secretary of the Consolidated Railway & Light Company in Vancouver. In April, 1897, he became associated with the British Columbia Electric Railway Company, and one year later was appointed to the position of general manager.

Mr. J. C. M. Buntzen,
Manager British Columbia Electric Railway Company.

From Railway and Shipping World, Toronto

The British Columbia Electric Railway Company is composed of British capitalists, Mr. R. M. Horne-Payne being chairman. The company operate electric railways in the cities of Vancouver, Victoria and New Westminster, and also supply light and power in these cities. The company is operating 48 miles of electric railway and supplying light to 548 arc lamps and 68,878 incandesent lamps. Power is supplied to motors aggregating 1,000 horse power, divided amongst 149 customers. The whole system is being operated most satisfactorily and the demand for power has increased to such an extent that the development of a water power at Coquitlam Lake is under consideration.

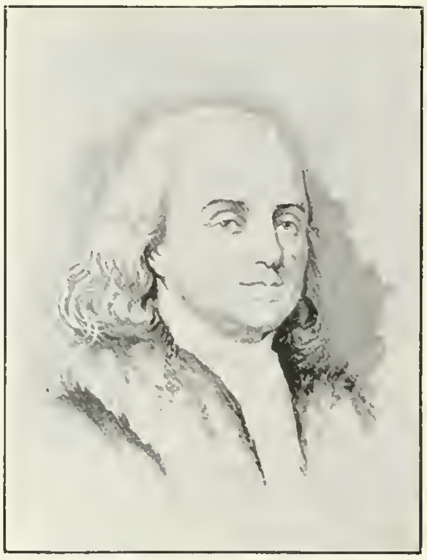
The success of the company under Mr. Buntzen's mangement is best shown by figures. The number of electric lights supplied by the company increased from 19,015 on October 1st, 1897, to 68,878 at the close of 1901. The net earnings of the company in 1897 were about $50,000, while for 1901 they were over $200,000.

OPENING OF SOULANGES CANAL.

The Soulanges canal was opened for the season of 1902 on May 1st, with the new electrical apparatus for working the lock gates, sluices, bridges, etc., in full and successful operation. The locks are handled by two men, one on each side. The heavy gates (60 tons) are opened or shut in one minute, and the sluices in forty-five seconds. The machines work with perfect ease, safety and smoothness, and are designed so as to be under complete control and thus obviate any chance of break-down if handled with ordinary care. Only about half the number of men necessary to operate the canal by hand are now required — the money saving being nearly ten thousand dollars per annum. An ordinary lockage can be made in less than ten minutes, and a tug has been run through the whole fourteen miles and five locks in two hours and ten minutes. The canal is brilliantly lighted throughout, and is as easily navigable by night as by day. The entire power and light installation, design of motors, etc., is the work of the Canadian General Electric Company, of Toronto. It may be stated that this canal does not resemble in any way the details of either the "Soo," Welland, or the other St. Lawrence canals, and affords the best specimen of an artificial channel of fifteen feet draught hitherto constructed on this side of the Atlantic. The depth in the summit level, at mean stages of Lake St. Francis, is about seventeen feet, rendering it easily practicable to run its whole length of ten miles in about an hour without danger to the banks.

Messrs. F. H. Leonard, jr., of Montreal, and F. M. Campbell, of Kingston, have fixed the sum which the town of Rat Portage, Ont., shall pay to the Citizens' Electric & Telephone Company for their plant at $58,192. The town could have bought the plant some weeks ago for $55,000, but refused the offer and submitted the matter to arbitration, with the above result.

Dr. William Gilbert,
Died Nov. 30, 1603. Celebrated Physician and Natural Philosopher. Founder of the Sciences of Electricity and Magnetism.



Benjamin Franklin,
Died 1790. Philosopher, Statesman, Diplomatist, Author and Inventor. Discoverer of relation between Lightning and Electricity.

Count Alessandro Volta,
Died 1827. Celebrated Physicist. Inventor of the Electrophorus, the Electroscope, and the Voltaic Pile. The Unit of Electro-motive Force, the Volt, is named in his honor.

Andre Marie Ampere,
Died 1836. Celebrated Physicist and Mathematician. Renowned for his investigations in Electro-Dynamics. The Unit of Electric Current, the Ampere, is named in his honor.

George Simon Ohm,
Died 1854. Celebrated Mathematician and Physicist. Discoverer of Ohm's Law. The Unit of Electrical Resistance, the Ohm, is named in his honor.

Michael Faraday,
Died 1867. Celebrated Physicist and Chemist. Discoverer of Magneto-Electric Induction, Magnetic Polarization of Light, Diamagnetism, etc.

Samuel Finley Breese Morse,
Died 1872. Inventor of the Telegraph.

James Prescott Joule,
Died 1889. Celebrated Experimental Physicist. Renowned for his Experimental Determination of the Mechanical Equivalent of Heat and the Law of Heating in the Electric Circuit.

Sir Humphrey Davy,
Died 1829. Celebrated Chemist. Discoverer of the Electric Arc Light and Inventor of the Miner's Safety Lamp.

CELEBRATED ELECTRICIANS AND INVENTORS.

Reproduced by permission of the Electrical Engineer Institute of Correspondence Instruction, New York, from their Booklet, "Can I Become an Electrical Engineer,"

TESTS OF THE NERNST LAMP.

Mr. R. P. Hulse, in a paper read before the Birmingham Local Section of the British Institution of Electrical Engineers, gives the result of tests of the Nernst lamp as it is now put on the market. The tests comprised the measurement, on a direct-current circuit, of the life, candle power and watts, under the following conditions : Continuous run at normal pressure ; continuous run at pressures below and above normal ; continuous run with constant current ; continuous run with constant watts expended in rod ; test with varying volts (increasing until burner is destroyed) ; resistance test on the iron regulating resistance ; and heating effect of coil. The lamps were fitted with 100-watt 110-volt burners. The candle power was ascertained by comparison with standard Ediswan glow lamps, using an ordinary grease-pot photometer. The lamps were run with continuous current only, which was obtained from a battery of accumulators, by which a much more steady current was maintained than would have been possible with the mains, the excess volts when charging the battery being cut down by a regulating resistance. The average variation was less than half a volt.

All the lamps tested were protected by globes, and the results obtained from a ground-glass globe reduced to the clear-globe standard for comparison. The effect of removing the globe is to cool the luminous rod, increasing the resistance and diminishing the current by about one per cent. The run was continuous, only one break occurring in the circuit during the seven weeks, and that but for a few seconds.

The accompanying diagram (Fig 1) shows the behaviour and life of the Nernst lamp when run at constant pressure. Three lamps, each marked 100-watts 110-volts, were tested on 109.5 volts and a mean curve plotted from the three sets of curves obtained. These three were substantially the same, the large decrease (Fig. 2) and slight recovery being shown in each; and after this a steady diminution of candle power until 400 hours, the efficiency during this part also diminishing. After 400 hours there was another sudden drop, and then the state of the rod seemed to change, for there was a slight rise in efficiency and candle power up to the point where the burner broke. The table of life tests on normal voltage is as follows:—

LIFE TESTS ON NORMAL VOLTS (109.5).

Mean values from curves representing three separate tests.

Hours after start.	Current Amps.	Watts absorbed.		Candle-power.	Watts per c. p.		Resistance of rod. Ohms.
		Total in lamp	Per cent. on rod only.		Total.	Rod only.	
0	0·917	100·5	88·4	66·8	1·51	1·33	105·6
1	0·913	100·0	89·1	62·9	1·59	1·42	106·8
3	0·906	99·2	90·1	57·6	1·72	1·55	108·9
10	0·903	98·8	91·2	55·4	1·79	1·63	110·7
50	0·904	99·1	92·7	52·9	1·87	1·74	112·2
100	0·892	97·7	94·0	49·4	1.98	1·86	115·2
150	0·858	94·0	95·1	45·7	2·06	1·96	121·2
200	0·836	91·6	95·7	43·9	2·09	2·00	125·2
250	0·803	88·0	96·1	40·0	2·20	2·11	131·0
300	0·766	83·9	96·7	35·4	2·37	2·29	138·2
350	0·724	79·3	97·3	30·1	2·64	2·57	147·0
400	0·692	75·8	97·7	28·5	2·66	2·60	154·5
450	0·637	69.8	98·2	19·4	3 61	3·54	168·8
500	0·653	71·5	98.0	20·4	3·51	3·44	164·2

It will be noticed that the Nernst lamp begins by being abnormally good, but falls in efficiency by 20 per cent. or more in the first ten hours. Thenceforward it remains fairly normal almost to the end of its natural life, and then breaks up suddenly. There is a gradual fall in candle power during the normal run, but the watts fall also. Thus a 50-c.p. lamp starts off at 66-c.p. After 50 hours it is giving 53-c.p., and after 350 hours 30-c.p. The watts per candle are then 2.57, as against 1.74 watts per candle when the lamp was given 53 candles. The three lamps tested broke down after 509, 490 and 425 hours. The end comes in all cases by the breakage of the platinum contact at the positive end of the rod. It is evident immediately from the diagram that the lamps are done with in about 400 hours, but that a very fair economy is retained almost up to that point. This sudden breakdown seems to be the characteristic of the lamp. The natural life is very close to the 'economic life.' Therein it differs greatly from the glow lamp, which, if not removed, goes on running long after its efficiency has departed.

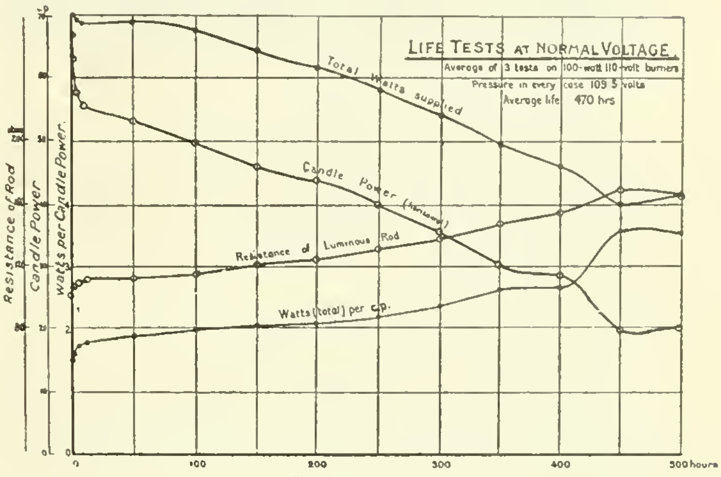


FIG. 1.

The author states that, assuming the cost per unit to be 6d., and that of the burner, fitting and depreciation of lamp and resistance as 3s., it is found by this method that it will pay to get a new burner at 350 hours; total cost being, up to that point, 19s.; candle-power-hours = 15,500 or 0.0147d. per candle-power-hour.

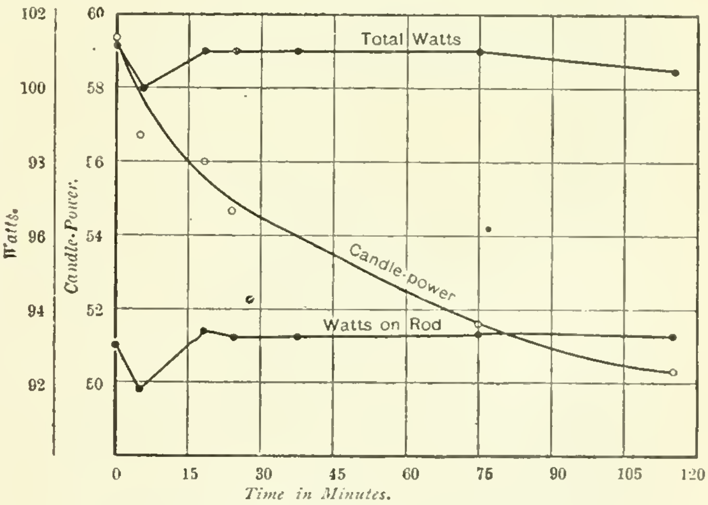


FIG. 2.—LIFE TEST ON NERNST LAMP. (109.5 VOLTS, 100 WATTS, 110-VOLT BURNER). FIRST TWO HOURS AFTER LIGHTING.

In conclusion the author makes the following summary:

The Nernst lamp will give on the average throughout a life of 400 hours at least ·48 c. p. per watt expended, as against not more than ·28 c.p. per watt in the case of good glow lamps. The cost of renewals would appear to be not more than three times as much for the Nernst as for the glow lamp, allowing for the shorter life of the former. In a 100-watt Nernst lamp the total energy used is over 35 units during economical life; and at 4d. a unit this costs 11s. 8d., or, say, not more than fifteen shillings when all expenditure due to renewal of the burner is taken into account. Thus the Nernst lamp will furnish 1,000 c.p.-hours at a cost of elevenpence; while fifteen pence is the approximate cost of the same amount of illumination from good glow lamps. In this comparative estimate the cost of renewals in each case has been included, the price per unit assumed to be 4d., while the glow lamp has been taken at an average of 3·6 watts per c.p. throughout a life of 700 hours.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Export Trade. JUDGING by the difference in price between British and Canadian motors, there seems to be an excellent chance for Canadian manufacturers in this line to do a profitable export business. Indeed, the Americans appear to have already discovered the fact, and are taking advantage of it. It is said that in one year four hundred American motors were sold in Sheffield alone. This is not surprising, seeing that a 2 h. p. motor is listed by the British manufacturer at £29 odd, or about $150, less 10 per cent., while the Canadian manufacturer's price is only $60. Adding $10 for freight and selling charges, there would still remain a handsome margin of profit. At least one Canadian firm proposes to exploit the British market.

An Example of Municipal Management. JUDGING by the statement of a correspondent who has recently taken charge of a municipal plant in a town of 2,500 inhabitants in Ontario, municipal management, in this instance at least, has not proved a success. We quote as follows from our correspondent's letter: "The plant is a municipal one, and in this case has been a failure, as they have operated for some time at a loss. They have not always had a competent man, and their equipment has suffered, besides their plant is overloaded and a certain amount of business which could be obtained is consequently sacrificed. The power house is in bad shape through carelessness and mismanagement, consequently my hands have been full remedying, as far as possible, existing poor conditions. We shall probably shut down for a few days and have a general overhaul."

Canadian Electrical Association. IT is gratifying to learn that the arrangements for the Annual Convention of the Canadian Electrical Association, which will open in Quebec on June 11th, are making satisfactory progress. A number of valuable papers have already been arranged for. These will probably include a paper by Mr. P. H. Thomas, Expert for the Westinghouse Company of Pittsburg, on the subject of "Static and Disruptive Discharges," from Mr. C. M. Green, Lynn, Mass., and Mr. W.D.A. Ryan on "Arc Lighting Apparatus", and from Mr. A.B. Lambe, jr., of Toronto, on "Street Railway Apparatus." The various committees are at work, and it is expected that all arrangements will be completed within a month. The Secretary is in receipt of many applications for membership, and much interest is being taken in the approaching meeting, which promises to be one of unusual interest. Our June number will contain the full programme for the meeting.

Motors. ELECTRIC motors have lately come into use for such a variety of purposes that the demand is constantly increasing, and manufacturers of the better class of machines are so crowded with orders as to be unable to accumulate any stock. Buyers are coming to understand that there are other considerations than price which ought to govern the purchase of a motor—in other words that there are motors and motors. There is the motor put together so roughly that a lot of current is lost in the bearings, in another there is heavy loss in the field, others are subject to burn-outs due to careless and improper winding of the armature. On the other hand, there are to be had motors so carefully designed and manufactured as to require the least possible expenditure for repairs, which operate smoothly and noiselessly and utilize all or nearly all the current supplied to them, in doing economically the work which they are set to perform.

Regulation of Railways.

A VOLUMINOUS report on railway commissions and railway rate grievances was presented to the Dominion Government last month by Prof. S. J. McLean, commissioner appointed for that purpose. Prof. McLean has evidently thoroughly investigated the question, and his report seems to confirm the contention that there is room for improvement in the regulation of railway rates and traffic. Acting upon his recommendation, Hon. Mr. Blair has introduced a bill in the Dominion Parliament providing for the appointment of a railway commission and to amend and consolidate the existing railway laws. The commission is to consist of three persons, one a lawyer of large experience and some knowledge of railway business, another an experienced railway man, and a third a man with large knowledge of general business. This board will replace the existing railway committee of the privy council, and in it is to be vested power to fix all traffic rates on railroads and lakes, rivers and canals. While the appointment of this commission is not likely to lead to the redress of all grievances, it is in accord with popular sentiment, and will probably result in securing more equitable rates for all classes and localities.

A School of Wireless Telegraphy.

THE success which has attended Mr. Marconi's invention, and the certainty that his system will immediately come into commercial use, has rendered it imperative that there should be available a considerable number of trained operators to take charge of installations on vessels and in the numerous stations which are about to be established in this and other countries. In order to meet this want, the Marconi Wireless Telegraph Company, of London, have established at Frinton-on-Sea, in Essex, a school for the training of students. As an inducement to students to take the course of instruction, the company pay a small premium, stipulating, however, that only those will be accepted who have passed through technical schools, or who show an aptitude for the work. The school is in charge of Mr. T. Bowden, who has been Mr. Marconi's assistant for a number of years. The buildings consist of two villa residences in which accommodation is provided for the students, who are required to sleep on the premises. The pupils are taught how to send and receive messages, and are thoroughly instructed regarding the mechanism of the various instruments. They are also taught how to make repairs, new parts, and to keep the instruments in proper working order. The period of instruction necessary, in the case of most students, is about four weeks. After a student has mastered the new alphabet and the technique of the instruments, he is put in charge of the Frinton station and held absolutely responsible for all messages received and answered. He is required to make out a daily report to the London office and reply to all enquiries.

Legal Matters Affecting Electrical Companies.

THE decision in the "scrap-iron" assessment case, given last month, is in favor of the electrical companies. The city of Toronto endeavored to take advantage of an amendment to the Assessment Act repealing the clause requiring that the real property of railway, telephone and electric light companies should be assessed in the wards in which it is situated. The city's contention was that the amendment did away with the scrap-iron clause and permitted the plants of these companies to be assessed as going concerns. The Court of County Judges held that the amendment to the act was merely an enabling clause to facilitate the work of the assessor. The Court of Appeal has upheld this judgment. The decision of the Courts regarding the purchase by the city of Kingston of the property of the Kingston Light, Heat & Power Company shows that when an electric lighting company enters into a specific agreement to dispose of its plant and franchise by arbitration, the clause of the law requiring that the city shall pay for the franchise a price equal to ten per cent. of the value thereof cannot be applied. The arbitrators decided that the franchise of the Kingston Company was worth $80,000, but that the city was not under any obligation to pay for it, owing to an agreement which gave the city the right to purchase the "works, plant, appliances and property" of the company at a price to be fixed by arbitration. This was the view taken by the courts. The decision is a warning to electrical companies to take every precaution in making contracts to provide against possible points of dispute.

ELECTRIC LIGHTING OF QUEBEC.

Two tenders were received by the city council of Quebec for electric lighting. There are at present 368 arc lights and 60 incandescent lights furnished to the city, the price being $80 and $25 per light per year. The tenders submitted were as follows: For arc lights, Quebec Railway, Light & Power Company, $69.80 per light per year for five year contract and $67.80 for ten year contract; Jacques Cartier Water Power Company, $54.00 for five or ten year contract. For incandescent lights, Quebec Railway, Light & Power Company, $25 per light per year for five or ten years; Jacques Cartier Water Power Company, $15 for five or ten years. Both companies tendered on the direct current system. The council has accepted the tender of the Jacques Cartier Water Power Company on a five year's contract. It is the intention of the company to immediately install a 1,800 h.p. reserve steam plant.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

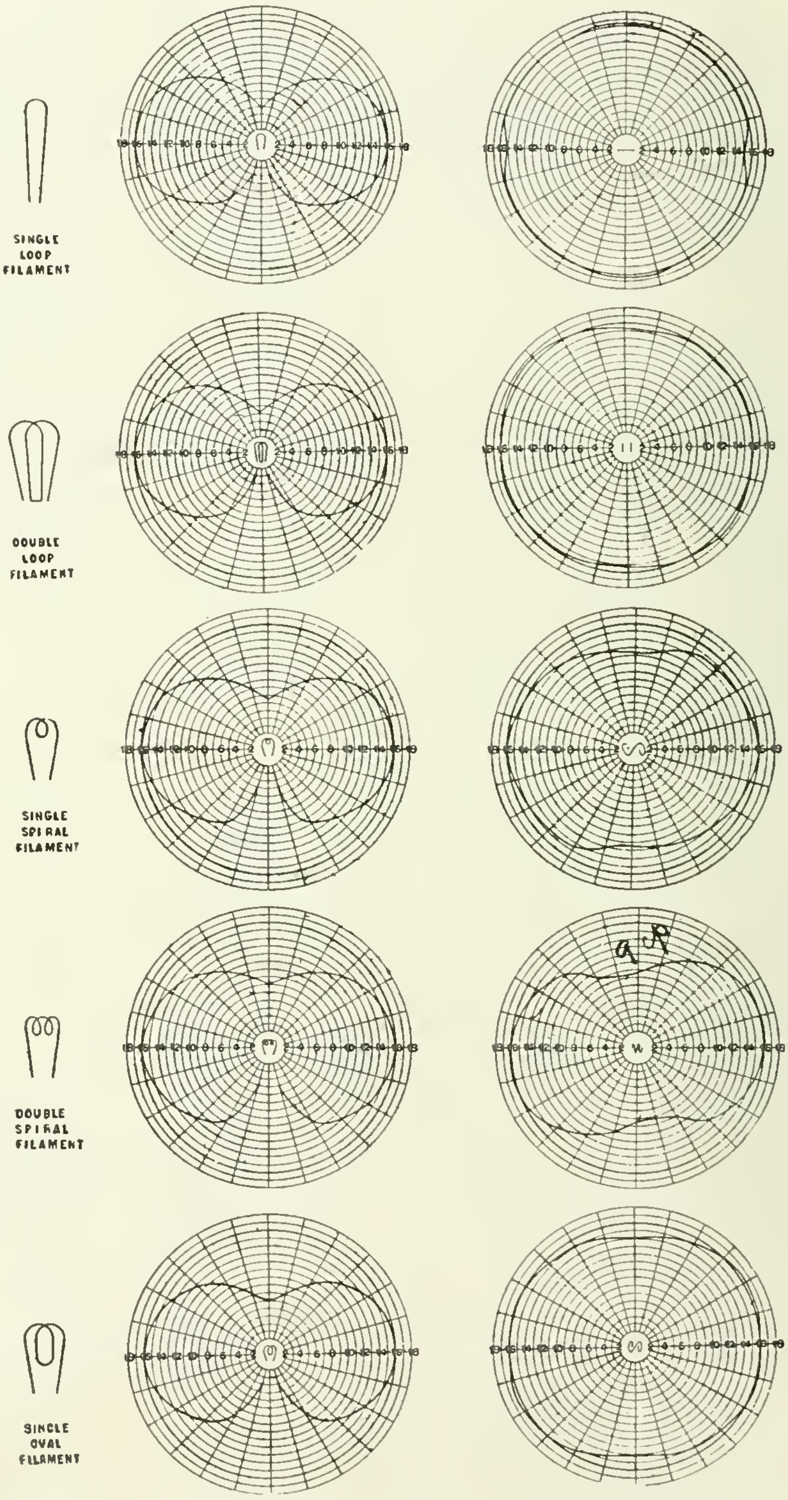
The annual convention of the National Electric Light Association of the United States is announced to be held at Cincinnati, Ohio, May 20-22. There has been a large increase in the membership of this association, and an interesting meeting is anticipated. The programme will include fewer technical papers than usual, but fifteen or twenty topics of practical interest to central stations have been selected and competent persons asked to prepare discussions upon them.

The Westinghouse Electric & Manufacturing Company has recently issued to the trade an attractive folder on Westinghouse lightning arresters. It contains an excellent description of the new Westinghouse low equivalent arrester, which has been received with such general favor.

A LAMP CATALOGUE.

Lamp users will doubtless appreciate the new lamp catalogue which has just been issued by the Packard Electric Company, of St. Catharines, Ont. It is of very attractive appearance and contains excellent illustrations of the standard types of Packard lamps. A distinctive feature of these lamps is the straight-sided or moulded bulb, now adopted by the leading lamp makers of the United States. Packard lamps are regularly made in efficiencies of 3, 3½ and 4 watts per candle. The company, in their catalogue, state that the lamps of 3 watts efficiency should only be used where the voltage is practically constant at all times; lamps of 3½ watts efficiency may be used on circuits where the voltage varies approximately 2 per cent., and lamps of 4 watts efficiency are for use on circuits where the voltage is fluctuating.

By permission of the Packard Company, we reproduce herewith several curves illustrating the vertical and horizontal distribution of light of the various forms of filaments in common use. The concentric circles represent the candle power from 2 to 18. The left hand column shows vertical, the right hand horizontal distribution.



POWER EQUIPMENT OF THE GRANBY SMELTER.

The Granby Consolidated Mining, Smelting & Power Company, of Granby, B. C., is said to operate the largest copper smelting works in Canada. During last year 230,928 tons of ore were treated at the Granby plant, the capacity of which is being increased. The location is on the north fork of the Kettle river, where 1,200 horse power is developed at extreme low water under an actual head of forty-five feet. The dam, according to the Mining Record, gives about thirty feet of this head, the rest being made up between the dam and the power house. The dam is 175 feet across the top, 75 feet from heel to toe on the bottom, built out of 12x12 inch sawn timbers, filled in with rock and gravel. The flume is 12x9 feet and one mile long.

The power house is within 1,000 feet of the smelter buildings and 100 feet below them. The power for driving the blowers, sampling works, converter, etc., is created by three double sixteen inch turbine water wheels, connected with the flume by steel intake pipes 4 feet 7 inches in diameter. Each wheel is directly connected with one Westinghouse rotating arm, altemating current generator. Another wheel is belted to two pumps, each with a daily capacity of 750,000 gallons. These pumps furnish water and pressure to granulate the slag as it runs continuously from the furnace.

All the machinery is operated by Westinghouse iuduction motors. There is a 75 h. p. motor for sampling works, a 30 h.p- motor for matte sampler, a 25 h.p. motor for the machine shops, and a 10 h. p. motor for the elevator in the main furnace building. There are three blowers, each being driven by a 75 h.p. Westinghouse induction motor belted directly to the blower.

By the enlargement now nearing completion the power plant will be increased by a 250 h.p. horizontal turbine water wheel and a 250 h.p. generator directly connected to the water wheel, making a total of 250 h.p. developed for the use of the city of Grand Forks. Two additional triplex power pumps, which will each supply 750,000 gallons of water daily, are being installed by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. The electrical plant throughout was furnished and installed by the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa.

CORRESPONDENCE

CABLE-LAYING.

WILKES BARRE, Pa., April 18th., 1902.

Editor Canadian Electrical News:

DEAR SIR,—I received your newsy little paper to-day, and in looking over it I notice with regret the death of Mr. C. W. Lundy. I also saw that you mentioned the name of Siemens Bros. as being connected with the Great Eastern Atlantic Expedition, and I think you are in error. The company which did this work was Messrs. Glass, Elliott & Company, which afterwards became The Telegraph Construction and Maintenance Company, which company you mention on the next column as laying the Pacific cable. Siemens had nothing much to do with cable laying until somewhere along about 1874, and its first really unqualified success was the laying of the Commercial cables in 1883. As to the Telegraph Construction & Maintenance Company, they have laid possibly 75 per cent. of the submarine cable in existence.

Very truly yours,

E. W. STEVENSON,

Electrician Hazard Manufacturing Company.

A NEW EXPERIENCE.

SHERBROOKE, QUE., April 14th, 1902.

Editor Canadian Electrical News:

DEAR SIR,—We had rather a strange thing happen on one of our street light circuits on Sunday evening, April 13th. I must first explain that we are running the series alternating current arc lamps, as supplied by the Canadian General Electric Company. We run two circuits from our station, about nine miles each circuit, having 47 lamps on one and 45 lamps on the other. On the night I mention it was wet and blowing, had been so all day; the circuits had been tried several times for any open or ground lines, but no appearance of any when started.

The patrolman went out as usual, but came back and said quite a few of the lamps were out on the circuit with the 47 lamps. This circuit is carried over a river and back on the same poles, and along a side street and back to the same street which it left before crossing the river. On one end of the circuit near the station there were five lamps burning, then a ground came on owing to one of the wires to the lamp coming in contact with a guy wire; the next twenty-seven lamps were out, and on the same street where first ground was another ground was on with wires solid on a tree. This was 2,200 feet distant from first ground. All the lamps beyond that on the other end of the circuit were burning without the least flicker—fifteen lamps—and burned for an hour; they were put on and off several times to find if the ground would show. The lamps all started up at once when the first ground mentioned was taken off; the other ground was taken off next morning.

The controlling device in the transformers worked to perfection with the 27 lamps off. The attendant did not observe any difference on the ammeters. When the patrolman came in and reported, he went and examined the lever on the transformer and found it higher than usual. The ammeter showed the pointer at the red mark which we have on the dial, and no jumping.

This experience may not be anything new to many of your readers, but it is something we have not had on our lines previous to this. I wish to add a word of praise for this system of arc lighting, and would advise any company who may be contemplating a change in their street lighting to examine into the system as supplied by the Canadian General Electric Company of Toronto. They will find the lamps and transformers the simplest and most flexible (for controlling the current) that is in the market.

Yours truly,

A. SANGSTER,

Superintendent Sherbrooke Gas & Water Company.

THE FUTURE OF THE STEAM TURBINE.

From a paper on the future of the steam turbine, by Mr. W. E. Warrilow, in a recent issue of the Electrical Review, some interesting facts about the advantages of the steam turbine may be gathered.

Possessing but one rotating part and requiring no special foundation, it embodies all that could be desired for coupling to any type of dynamo for direct or alternating current. The improvments effected in its construction and its employment in a large number of electricity works in this or other countries should indicate that it is destined to fill a prominent place in the generating stations of the immediate future. Unlike the early undertakings, the schemes which are now planned demand units having capacities running into thousands of kilowatts, instead of hundreds, so that the class of engine which the turbine represents has every opportunity of appearing to the best advantage, as far as steam consumption is concerned. This question of consumption of steam in pounds per kilowatt has been a favorite one with consultants, the makers of engines being encouraged by the offer of a bonus to reduce it as much as possible. The guaranteed performance of a reciprocating engine in this respect has often given it the preference over such an engine as the turbine, though no calculation has been made as to the possibilities of either engine to get out of order, or increase its steam consumption with time.

An important feature of the steam turbine, not always considered, is the freedom from great or sudden angular variations in speed. This defect in reciprocating engines has been noticed at length elsewhere in these columns, and it is one which is of constantly increasing importance. With its high rotative speed, and entire absence of reciprocating parts, it is practically impossible for any appreciable variation in speed to occur in the course of a single revolution, the speed changes necessarily extending over a number of revolutions, and being gradual in their nature, while with the use of properly proportioned governors, even these gradual variations in speed may be kept within very narrow limits.

A modern turbo plant of 1,500 kilowatt capacity will stand on a floor space of 728 square feet, and will have its own condensing plant at that. No foundations are needed for its reception, and no oil is necessary for the lubrication of the rotating parts acted upon by steam. In both these items it will be at once seen that large economies in time and material will be effected, the absence of oil in the steam especially enabling the condensed water to be returned to the boilers. The machine when delivered can be assembled on its particular portion of the engine room floor, and no vibration will take place while the plant is in motion. The appearance of the engine room will also be greatly enhanced, in that the turbo sets occupy little head room, and consequently will cut off little or no light from the windows. The small vertical space needed also does much to decrease the cost of buildings as well as the steam and exhaust piping for the turbine. Combined with these are, the little attention required both for running and maintenance, and the ease of manipulation for parallel running on account of the even turning moment.

That the early types of turbine were extravagant in steam is well known, but this fault was due to the comparative scarcity of data in the design of such engines, as well as the fact that very small units were required for electric supply purposes.

The day of the small station is, however, about to depart, so that the turbo set can appear to its best advantage under the improved conditions, and where the reciprocating engine must ultimately fail, the turbine can be looked to as a reliable substitute. Such a fact is not one to cause regret on the part of engineers; rather should they welcome the new engine as a means of deliverance from the difficulties which progression on the present lines must assuredly bring. The existing state of competition in all industries, but especially the electrical one, will no doubt keep the reciprocating engine in our midst for some years to come, though the same competition will also bring more prominently to the front the steam turbine, even to the extent of finally ousting its rival.

LEGAL DECISIONS.

Ottawa Electric Company vs. F. X. St. Jacques.—Recently the Supreme Court gave a verdict to the Ottawa Electric Company against F. X. St. Jacques, proprietor of the Russell House in Ottawa, for breach of contract, the defendent having cut the wires of the plaintiff about December 1, 1897, although the contract did not expire until October 31, 1900. The Court directed the local Master-in-Chancery to fix damages, which he placed at $5,413. His decision is given below:—

The plaintiffs and defendant are agreed as to the general principle which should govern the assessing of the damages, namely, that the parties are as far as possible to be placed in the position they would have been in had the contract not been broken. I need not therefore discuss any of the numerous cases referred to in that connection on the argument.

But the parties differ widely as to how that principle should be applied to the facts of the present case.

The plaintiffs allege that with their total installation of 63,000 lights, necessitating the carrying of a variable "load" of, in the neighborhood, of 19,000, which would always bear overloading to a greater extent than 600, the cutting off of the Russell House lights had no effect in reducing their general expense. They point out that their machinery is driven almost exclusively by water power, and that the water flows on and the wheels go round and necessitate the presence of the staff whether or not the electricity is being used. They say that their smallest generator has a capacity of 1000 lights, and that even, therefore, had their "load" been reduced by the total number of lights in the Russell House, it would not have enabled them to throw out a single machine and in that way save anything in wages of employees. They allege that the only possible items of expense saved to them by the cutting off of the lights were (1) the cost of lamp renewals, which under the terms of the contract they were to supply, and (2) the additional coal which they would have burned in their auxiliary steam station during the portions of each year that it was in operation, assuming that all of the defendant's lights would have been supplied from there. Particulars of these deductions will be found at pages 11 and 12 of the printed case, subject to certain corrections appearing in Mr. Dion's evidence on the reference, (pages 53 and 54). They amount altogether, according to the plaintiffs, to $1321.31, which sum, deducted from the $11,666.66 which they would have received under the terms of the contract, would make the damages calculated in this way, $10,345.35.

The defendant, on the other hand, contends that the true method of getting at the plaintiffs' loss is by taking their total revenue for the period in question, plus the $11,666.66 which they should have received under the contract, and deducting therefrom the total expenditure, including interests on loans, plus an allowance to represent depreciation of plant, to get the true profit; when, as he argues, the loss will be a sum bearing the same proportion to what would have been received under the contract as the total profit does to the total receipts. This method is worked out in Exhibit 12 and results in fixing on the total sum of $185.30 as the amount of the plaintiff's damages.

In addition to these, two other methods are suggested, which I will have occasion to examine later.

The plaintiffs cite, in support of their contention, the case of Boyd v Queen, a decision of Mr. Justice Henry, sitting as a Judge of the Exchequer Court, reported in 1 Exchequer Court (Canada) at page 186. The defendant, on the other hand, relies on Woodburn v The Queen, decided by Mr. Justice Burbidge and reported in 6 Exchequer Reports (Canada) at page 12. Both were suits for damages due to the giving to outside parties by the Dominion Government of work which should have gone to the suppliants under their respective contracts. The defendant's counsel seemed to assume that the decisions were in conflict, but they do not appear to me to be so. The facts in the two cases, or perhaps the views respectively taken of them by the two learned judges, differed, but the same principle underlies both decisions. In the Boyd case the items sought to be deducted from the contract price were additional superintendence; and a proportionate amount for depreciation of plant, rent and depreciation of buildings, insurance on buildings, machinery, fuel and taxes and water rates. Mr. Justice Henry held that had Mortimer actually done the work in question he would not have had to pay out anything more under any of the several heads than he had in fact paid out in carrying on his ordinary business, and he disallowed the items. In the Woodburn case the contention was that no amount should be deducted to represent the wages that would have been paid out for the performing of the work, the suppliant alleging that he had staff enough to have done all of the work in question in addition to his regular work, and that, had he done it, he would have been at no extra expense for wages. Mr. Justice Burbidge says regarding this contention:

"I do not believe it to be possible that the additional work in this case could have been done without any extra cost for labor, if the work sent to the suppliant and executed by him had been done in a prudent and careful business manner."

To my mind this judgment of Mr. Burbidge assumes what Mr. Justice Henry in the other case expressly decides, that in getting at the damages in a case of this kind, the only deductions which should properly be made from the contract price, are amounts which the party would have actually had to pay out had he performed the work. This is the principle contended for by the plaintiffs and to my mind it is the true one, for in that way alone can an amount be arrived at which will place the party in the same position as if the contract had never been broken.

Such being the case, are the plaintiffs right in contending that the only extra expense they would have been put to had the contract been carried out would have been the cost of lamp renewals and of the extra coal that would have been burned at their steam station? I do not think so. Suppose that from the beginning to the end of the period in question their total installation, their average load, their working expenses, and their business generally had remained absolutely the same; suppose they had added no machinery and made no other alterations in or additions to their plant, and that the cutting off of the Russell House lights did not enable them to throw out a single generator and thus save anything either in wages or wear and tear. Under such circumstances I quite agree that in arriving at the damages the only items to be deducted would be those they contend for. But the facts are far otherwise. Instead of being at a standstill the plaintiff's business was a rapidly increasing one. Taking their annual statements for 1898 and 1901 respectively, (put in as Exhibits 4 and 5) it will be seen that in the three intervening years their total revenue increased from $159,583 54 to $196,363.22; their total expenses from $109,117.61 to $160,379.86; the value of their assets from $1,249,636.21 to $1,551,247.67, and their total installation of incandescent lights from 63,113 to 93,207. How can it be said in the face of these figures, that the cutting off of 600 or 750 lights made no difference in their expenses, other than under the two hears mentioned? It doubtless had no recognizable effect, in so far as the Company was concerned, but it certainly had some effect—an effect which I am bound to endeavor to measure. The proverbial "drop in the bucket" may have no appreciable effect on the amount of water therein, but every added drop hastens the moment when the filling of the vessel necessitates the replacing of it by another. Take the case of the Company's generators and suppose that for every 2000 lights added to the total installation a new generator must be put in. The addition of 600 lights, even though they themselves may still be carried on the existing machines, brings the Company that much nearer to the time when the new generator must be put in; and, conversely, the cutting off of 600 lights postpones to a like extent that day. It is said that a variable load of only about one-third of the installation is carried and that the machinery will always bear overloading to a greater extent than 600 or 750 lights; but this, to my mind, does not affect the question. It is clear that the load must bear a proportion, varible perhaps, but variable within fixed limits, to the total installation. The load carried in 1901 must be greater than that carried in 1898 in proportion, or at all events, roughly in proportion, to the difference in the installation. It follows from this that every change in the installation by the additional or substraction, not alone of 600 lights, but even one single light, has an effect, though perhaps an extremely slight effect, on the total load carried, and consequently, on the number of generators in use and the cost of running them. The same argument applies to all of the various items of expense and I think proves conclusively that in order to arrive at the amount which the plaintiffs would have been in pocket had the contract been carried out, the deductions from the contract price should by no means be limited to the two items of expense suggested by them.

How, then, of the method suggested by the defendant? It is open to the obvious and, I think, fatal objection that it assumes all of the Company's contracts to have been equally profitable. Suppose the Company's business in general was being carried on at a loss, but that the present contract was entered into at a figure which made it profitable. According to this mode of calculation there would be no damages—the balance might in fact be largely the other way. The possibility of such a result shows the unreliability of the method.

Two alternative calculations, based on the supposed cost per light, are put in, one on behalf of the plaintiffs by Mr. Dion (Exhibit 2) and the other on behalf of the defendants by Mr. R.A. Ross (Exhibit 11). Mr. Dion's calculation is a working out of the following proportion:—The average maximum load carried is to the total year's expenses as the number of the lights in question is to the proportion of those expenses attributable to those lights. Mr. Ross' formula is somewhat similar but is based on what he considers to have been the average daily lamp hours.

Before proceeding to deal with these calculations it will be necessary to dispose of three preliminary questions much debated on the argument. The first of these is as to whether or not sums paid out by the Company as interest on debentures and other loans to them should be included in the expenses, the proper proportion of which must, according to either method, be deducted from the contract price in arriving at the profit which the plaintiffs have lost by reason of the defendant's breach of contract. I think clearly not. It is admitted that dividends should not be included and interest appears to me to be on much the same footing. Take the following illustration: Suppose two men are carrying on the same business side by side under precisely similar conditions and with the same amount of capital invested—say $10,000, the only difference is that whereas "A" has furnished his own $10,000, "B" has only furnished $5,000, borrowing the other $5,000 from a bank at 6%. Could it be said that the cost of manufacturing the articles was greater in the case of "B" than in that of "A"? Suppose, furthur, that "B" might have advanced the additional $5,000 out of his own funds but preferred to leave it invested at say 8 per cent. and to borrow the amount at 6 per cent., thus saving 2 per cent. The whole arrangement is, suppose, a more advantageous one to "B" than "A's" is to him. In the event of assessments of damages by the two manufacturers similar to the one as we are now dealing with, could it be said that "A's" loss was greater than "B's"? The proposition has only to be stated for the absurdity of it to appear. Leaving out of the question the $300 that "B" pays to bank for interest—by which arrangement he nets $120 more than, on the supposition, "A" does—both men lose exactly the same amount per article by reason of the non-fulfillment of the respective contracts. Clearly "B's" loss cannot be less than "A's." I think the key to the situation is to be found in the distinction drawn by one of the witnesses between the gross profits of a business and the net profits. The former is the difference between the actual cost of manufacture (including of course marketing) and the selling price ; the latter is the amount which eventually reaches the pockets of the shareholders or manufacturer. Interest paid on money expended on plant, while it certainly affects the net profits, is not to be considered in calculating the gross profits, and it is with them that we have to do here.

The second question is as to depreciation of plant, the defendant contending that in calculating the plaintiffs' profits, and conversely the cost of producing light, a percentage should be written off under that head. It is not the custom of the plaintiffs to write off anything in their books for depreciation. A rest account is maintained which serves the same purpose. Moreover, the Company's plant is by constant repairs and renewals maintained in a high state of efficiency. It is also being constantly enlarged, renewed and added to, expenses of this character being charged to capital account. The company also point out that their water privileges and their franchise are always increasing in value and they say that this is of itself sufficient to offset any depreciation in the value of their plant. It seems to me that depreciation of plant, whether due to wear and tear or to what has been called "novation," is in a position somewhat analagous to that of interest. It is a question of impairment of capital. Plant is capital, and while an amount to offset its depreciation may very properly be deducted before ascertaining the net profits, it does not appear to me to affect the gross profits. Moreover, where one portion of the plant is increasing in value to an amount equal to or greater than the depreciation of the balance, the total value of the plant is not decreasing and it may be unnecessary to make any deduction for depreciation even in the net profits. The question is by no means free from doubt, but on the whole I think I would make no deduction under this head either.

The third preliminary question which it is necessary to determine is, what number of lights would the plaintiffs have had to maintain during the period in question had they continued to light the defendant's premises under the contract. The calculations of the plaintiffs are based on 600, though it was argued for them that the number should be only 549. The defendant's calculations, on the other hand, suppose 750, though evidence is given on his behalf of their being as many as 789 covered by the contract at the time of the cutting of the wires. The contract which will be found at page 36 of the printed appeal book was for all the "electric incandescent lights on the premises at present occupied by (the defendant), being the Russell House on Sparks street, Ottawa," subject to the following exception : "It is understood that the lights in the dining room, rotunda and kitchen are not included in this contract." The most important evidence as to the number of lights in operation at the time of the breach, is that of Louis Charbonneau, a porter in the hotel, whose duty it was to look after the lamps, repairing them when out of order and putting up new ones when necessary. His count, the result of which is contained in Exhibits 12 and 14, shows 789 lights exclusive of those in the rotunda, dining room and kitchen, made up of 240 on the ground floor and in the basement, and 549 in the upper halls and bedrooms. The latter figures are admitted to be correct, but the plaintiffs contend that it was never intended that they should light, under this contract, any portion of the hotel below the bedroom flats. There is no warrant for this in the agreement and I cannot so hold. The plaintiffs were bound to light the whole hotel, other than the dining room, rotunda and kitchen, and I cannot accede to their contention that pantries, servant's quarters, etc., are included in term "kitchen." There are, however, some lights shown in Exhibit 13, such as those in the cigar store and billiard room, which Mr. Street says were always paid for separately. These two portions of the hotel were sub-let and possibly the parties agreed that they were not, properly speaking, part of the hotel. Mr. Street produced an account for 132 extra lights, rendered to the defendant on February 11th, 1898 (Exhibit 16). Of these, four in the dining room and forty-six in the rotunda are not in question, reducing the number to 82. It will be noted that the account was not rendered untill sometime after the present dispute arose, and although amounting to $280.75 it was settled at $125. It would not therefore be safe to place too much reliance on it as a piece of evidence. Deducting all lights which can on the evidence fairly be deducted from those included in Exhibit 13, there still remain considerably over 700 which I think I should find were being operated under the contract at the time of the breach. There is another consideration which appears to be material. The agreement did not limit the number of lights and Charbonneau says he was in the habit of putting in additional ones whenever required. It would seem therefore highly probable that had the plaintiffs continued to light the hotel for the period in question the number of lights would have continued to increase as they evidently had previously been increasing, and this, quite apart from lights installed in new portions of the hotel, which it might have been contended could not fairly have been included in the lighting the plaintiffs had contracted to do. On the whole I think it a reasonable conclusion that the plaintiffs, had they continued to light the defendant's premises under their contract, would have had to maintain on an average in the neighborhood of 750 lights, and I shall, I think, be coming as near as practicable to the true facts if I find the number on which the calculation of the damage should be based, to be 750 as contended by the defendant.

Returning to the calculations set forth respectively in Exhibits 2 and 11, of the charges for interest and depreciation are dropped from the latter and the former is put on a basis of 750 lights, they are found not to differ very materially from each other. In fact, Mr. Ross arrives at a result more favorable to the plaintiffs than does Mr. Dion. If I have rightly understood it, the attitude of the Company with regard to the calculation in Exhibit 2 is as follows : They of course contend that the true mode of assessing the damages is that followed in the particulars at pages 11 and 12 of the printed case. If, however, the cost per light is, contrary to their contention, to be taken as a basis, then they say the damages should be arrived at in the manner indicated in Exhibit 2. I have already found that the plaintiff's original contention is not supported by the evidence. The method suggested by the defendant being equally faulty, the only remaining basis for the calculation of damages would seem to be the cost per light. On that basis I must say I think the mode of calculation adopted in Exhibit 2 is most liberal to the defendent. It will be seen that Mr. Dion has treated the matter as though the whole of the Russell House lights were burning at the times when the maximum loads were recorded. I cannot help thinking that this was at first an oversight, but when giving his evidence Mr. Dion said he was in this way allowing for any loss on the lines (questions 208-209) or any possible mistakes in approximations (questions 238-246). His opinion was that not more than 400 out of 600 lights would probably be burning at once, but in view of Charbonneau's evidence I should say, taking the whole year round, 400 would be decidedly an outside figure. Mr. R. A. Ross, it is true, stated that lights paid for on "flat" rates were always treated as "load," or, in other words, it was assumed that, the cost not depending on the hours of burning, such lights would be kept burning for at least a portion of every night. There is doubtless some modicum of truth in this, but on the evidence it was clearly not true of the Russell House lights. In the result, however, both Mr. Dion and Mr. R. A. Ross agree in treating the whole Russell House installation as "load," though they give different reasons for doing so. It will be found, on figuring out, that the average maximum load of incandescent lights in the first year in question stood to the Company's total installation of incandescent lamps in the ratio of 1 to 3.377, and Mr. Dion in working out his calculation might well have assumed to take 1/3.377 of the Russell House lights instead of the total number. There could have been no question of loss on the lines, since the proportion is between the total average maximum load and the total installation. And, as regards possible mistakes in approximations, they appear to me as likely to work in favor of as against the defendant. On the other hand, the calculation would have been based on the assumption that the defendants lights would have been burned on the same average as all other lights installed, including those paid for at meter rates, an assumption no doubt too favorable to the plaintiffs. I have myself taken the trouble to work out the cost per light on this basis, the following being my figures :

Taking the first year, 1897-98, the total installation of incandescent tights was 63,113. The Company, however, also supplied arc lights and motor power, and as expenses were not kept separately it is necessary to take account of them. Mr. Dion has given us the equivalent to these incandescent lamps as being, taking the average, 5,500 and 3,190 respectively, but these figures represent loads, and must be increased to represent installation. The average maximum load for incandescent lights in that year, based on the figures in Exhibit 2, was 18,690. Carrying the calculation to the third decimal, this is, as I have said, 1/3.377 of the installation. Multiplying 8,690, the sum of 5,500 and 3,190 by 3.377 gives 29,346 as the installation that would be represented by the arc lights and motors. This added to the 63,113 gives the equivalent of an installation of 92,459 in that year. The total expenses of the year, after deducting interest, were $84,186.16, but as the period in question included only five months of that year, we must take five-twelfths of that sum or $35,077.57. Dividing this by 92,459, the total installation gives .37926 as the cost per light for that portion of that year, or for 750 lights, $284.45.

In the second year, 1898-99, the total installation of incandescent lights was 77,255, and the average maximum loads for arc lights and motors were 5,500 and 3,975 respectively, or a total of 9,475. Assuming that the ratio of load to installation remained about the same as in the previous year, and multiplying the 9,475 by 3.377, we get 31,997 as the equivalent in incandescent lamps installed, of the arc lights and motors, or a total installation of 109,252 incandescent lamps. Dividing this into $91,298.00, the total expenses exclusive of interest, gives a cost of .83566 per light, or $626.75 for the 750 lights.

In the third year, 1899-1900, the total installation of incandescent lights was 87,114 and the average maximum loads for arc lights and motors were 5500 and 4625 respectively, or a total of 10,125. Multiplying this again by 3.377 gives 34,192 as the equivalent in incandescent lamps installed of the arc lights and motors, or a total installation of 121,336. Dividing this into $100,518, the total expenses exclusive of interest gives a cost of .82842 cents per light or $621.32 for 750 lights.

In the fourth year I do not appear to have the figures for the maximum loads, but the total installation of incandescent lamps was 93,207, and assuming that the equivalent in installation of incandescent lamps of the arc lamps and motors increased this year in the same ratio as in the previous year, the figures for them would be 34,648, making a total installation of 127,855. The total expenses for the year were $133,867.80 (See Exhibit 6), and taking six-twelfth of this, or $66933.90, and dividing into it the total installation, we get .52438 as the cost per light for the first six months of the year or $393.29 for 750 lights.

Summing up the cost, if this method of calculation were correct, would be :

1st five months	$284.45
2nd year	626.75
3rd year	621.32
Last six months	393.29
	$1925.81

Deducting this from the contract price of $11,666 would leave the loss $9740.19. No doubt, as I have said, this method is too favorable to the plaintiffs, based as it is on the assumption that the Russell House lights were not kept lighted any more than the average of lights installed, including those paid at meter rates, but on the other hand, Exhibit 2 undoubtedly errs in the other direction.

The truth is that without further data which is not before me, and in fact is not available, it is impossible to arrive at a really accurate result. However, as the plaintiffs, if the cost per light must be taken as a basis, are satisfied with the method of arriving at it employed in Exhibit 2, I do not see that I can do better than adopt it. Mr. Dion makes the damages calculated in this way $6,664 for 600 lights. For 750 lights this would mean $5,413 and at that figure I assess the plaintiff's damages.

It will be seen that in adopting these figures I am largely influenced by the fact that they are the result of the Company's own calculation. If it were necessary to make any material alteration in the basis of that calculation—if for instance I felt bound to add to the expenses the amounts paid for interest and a percentage on the value of the plant by way of depreciation—I would not in that event deem it fair to hold the Company in other respects to their figures. Mr. Dion has allowed a liberal margin, perhaps enough even to cover interest and depreciation. Taking $1925.81, the cost of the lights on the basis of my own tentative figuring, and adding to it $626.46 and $1432.84, which are the total charges for interest and for depreciation respectively, according to Mr. Ross' figures, as corrected by Mr. Street (ppl 44 and 145 qq 20 and 22), on the basis of treating the Russell House lights as installation instead of load, we get a total of $3985.11, which deducted from the contract price would leave the damages $7680.89, a sum greater than the amount at which I am fixing them. As I have said, this method is too favorable to the plaintiffs. On the other hand, in Exhibit 2, the Company have been, as I think, unnecessarily liberal to the defendant, and as I have said, were I obliged to make allowances for interest and depreciation, I should deem it unfair to hold them to their figures and should feel bound to search for some other and more equitable basis of calculation.

Re. City of Toronto Assessment Appeals.—Judgment (R) on appeal by the city corporation from a decision of the County Judges of York, Halton and Ontario, upon the question of the assessment of the Bell Telephone Company, the Toronto Electric Light Company, the Toronto Railway Company and the Toronto Incandescent Light Company, in respect of their assessments for plant, including wires, poles, etc. The Board of County Court Judges reduced the assessments as confirmed by the Court of Revision. The question upon the appeal was whether the Board of Judges were right in deciding that the act 1 Edw. VII, ch. 29, sec. 2 (O), made no difference in the mode of valuing the rails, poles, wires and other plant belonging to the companies, erected or placed upon the highways, which was held to be proper by the decision in re Bell Telephone Company and City of Hamilton, 25 A. R. 351, and re London Street R. W. Company. Held, Maclennan, J. A., dissenting, that the Board of Judges were right in so deciding. Per Osler, J. A. :—The new clause does no more than enable the assessor to assess their property all together in one ward, or to apportion the assessment among two or more of the wards, as he may deem it convenient. It merely removes one of the difficulties pointed out in the cases before decided, but does not extend the principle on which the value of such property, apart from the franchise of the company or its use to a going concern, is to be ascertained by the application of the rule provided by sec. 28 of the assessment act for ascertaining its value. It is now to be valued as if it were all in one ward. That is to say, as a whole or as an intergral part of a whole, but still without reference to its connection with a franchise or its use as the property of a going concern. The learned Chairman of the board (McDougall, Co. J.) has given a very full and satisfactory exposition of the new section, to which nothing can be added, except that the decisions by which the Court of Appeal is bound require much more comprehensive legislation to remove their effect than anything which is found in that clause. Per Maclenna, J. A. (dissenting.) The injunction to assess all property at its actual cash value still remains. So does the mode of appraisement as if in payment of a just debt from a solvent debtor. But the obligation to assess in several wards is swept away, and it may be assessed all together in any one ward, or it may be apportioned amongst two or more wards, and in either case it shall be valued as a whole, or as an integral part of a whole. Each of the companies owns, and is assessed for, freehold land in the ordinary sense, as well as for their rails, poles, wires, etc., upon the public streets, and the two kinds of real estate are connected, both in construction and in use, and, taken together, answer the description in the sub-section "real property belonging to. . . any. . . incorporated company, and extending over more than one ward in any city," and what the section says is, that it may be assessed together in any one of such wards. That is what has been done here. It has been valued as a whole, that is, as if the company, being solvent, were conveying the whole to a creditor in payment of a just debt. In valuing the land of the company extending over several wards as a whole, the value of rails, poles, wires, etc., must be included as a part of the whole. But even if it becomes necessary to value a part of the company's real property separately, as in the case of that part which may be in a township outside of a city or town, where perhaps it has no land other than the rails, poles, wires, etc., on the public highways, the result must be the same. It must be the full value of these fixtures to the company, because they must be valued as an integral part of the whole. It plainly means that it is not to be valued without reference to the whole of which it is a part, but as an essential part of the whole—as something without which the whole would be incomplete. It is to be valued, in short, at what it is worth to the debtor, being solvent, as a part of the whole, so that being solvent, would be willing to let it go at that value in payment of a debt. Appeal dismissed with costs.

A CANADIAN ENTERPRISE IN BRAZIL.

A special meeting of the directors of the Sao Paulo Tramway, Light & Power Company, Limited, was held in Toronto on April 30th. This company is composed chiefly of Canadian capitalists, who have invested in an electric railway, light and power enterprise at Sao Paulo, Brazil. Mr. William MacKenzie is president and Mr. Frederic Nichols vice-president of the company.

At the meeting in question, it was decided to increase the capital stock of the company from six million to seven million dollars, this being necessary owing to the growth of business. The original capitalization contemplated the building of an electric railway in Sau Paulo, the development of water power at Parnahyba, the erection of power transmission line and the purchase of right of way. As the undertaking progressed the company further acquired by purchase the Sao Paulo Electric Light Company, the Viacoe Mule road, and the Santo Amaro Railway. It is now proposed to extend the company's electric railway line, increase the number of motor cars and the capacity of the lighting and power plant, provide additional transmission wires from Parnahyba to Sao Paulo, acd a second pipe line at the hydraulic plant. These extensions and improvements are estimated to cost about $750,000 and are expected to largely augment the present earning power of the company.

The electric railway commenced to be operated in May, 1900, the motive power being furnished from a temporary steam plant until the completion of the water power plant in September, 1901. For the fifteen months' operation with steam, the net profit was $139,823, but the next succeeding four months when operating by water power, showed a net profit of $151,333, making a total net profit up to the 31st December, 1901, of $291,156. Since that time the net earnings of the company have steadily increased. A dividend of 5 per cent. for the past year was declared.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.		Extinguish.		No. of Hours
		H.M.		H.M.	H.M.
1	P.M.	8.00	P.M.	3.30	7.30
2	"	8.00	"	3.30	7.30
3	"	8.00	"	3.30	7.30
4	"	8.00	"	3.30	7.30
5	"	8.00	"	3.30	7.30
6	"	8.00	"	3.30	7.30
7	"	8.00	"	3.30	7.30
8	"	8.00	"	3.30	7.30
9	"	8.00	"	3.30	7.30
10	"	8.00	"	3.30	7.30
11	"	10.00	"	3.30	5.30
12	"	10.30	"	3.30	5.00
13	"	11.00	"	3.30	4.30
14	"	11.40	"	3.30	3.50
16	"	0.10	"	3.30	3.20
17	"	0.45	"	3.30	2.45
18	"	1.20	"	3.30	2.10
19	No Light.		No Light.		....
20	"		"		....
21	"		"		....
22	"		"		....
23	A.M.	8.10	A.M.	10.40	2.30
24	"	8.10	"	11.10	3.00
25	"	8.10	"	11.45	3.35
26	"	8.10	"	0.15	4.05
27	"	8.10	"	0.45	4.35
28	"	8.10	"	1.20	5.10
29	"	8.10	"	2.00	5.50
30	"	8.10	"	2.30	6.20

Total............137.10

QUESTIONS AND ANSWERS

If "W.B" will send his name and address, and explain fully the points on which he desires enlightenment, we shall endeavor to supply the information.

"Subscriber," Elmvale, Ont.: I am at present running a high speed Ideal engine (9 x 10), revolutions per minute, 350. Can I by putting in a counter shaft and reducing my speed to one half get the same power out of it? Explain fully.

Ans.—You will be able to get just the same power from your countershaft, no matter what the speed, except for the losses in it, or to put it another way, the horse power which will have to be developed by the engine to do a given amount of work will be greater, say by 10 per cent., if a countershaft is employed than if it is not used. We presume that you intend to keep the speed of the engine constant; its power will vary almost directly with its speed.

"Reader": What would be a good dressing to put on a Manilla rope cable to help keep it from wearing? It has been in use now three years. We use it on an engine developing 150 h.p. It is 1¾ inches in diameter. How long do you think such a cable should last? There are four strands running off the drive wheel of the engine and one off the tightener, and five on the driven pulley on the line shaft. The distance between the line shaft and the engine shaft is about thirty feet. The tightener pulley, 3 feet in diameter, is one-third way between the two shafts, engine flywheels 10½ feet diameter, pulley on line shaft 4 feet.

Ans.—Dressings for Manilla power transmission ropes are composed principally of graphite and tallow, with a binder such as molasses. The exact ingredients and the proportions in which they are used are more or less trade secrets, all dealers in ropes for this purpose carry in stock dressing for their own particular brands. Your most advisable course is to buy from them and use according to their directions. It is difficult to estimate the life of a rope, from 3 or 5 to 8 or 10 years, depending very much on the load (strain or tension), velocity, care, etc.; under good average conditions you should get a life of seven or eight years. See answer to "Ned" in issue of December last.

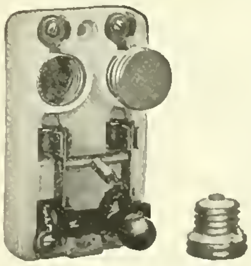
"Student": In answering my question No. 3, in the last number of the News, you say: "The term true watts is sometimes used in alternating correct work, to distinguish that part of the current in a circuit which is in phase with the voltage from that part which is out of phase." I would ask, 1st, if the expression "in alternating correct work" as given by the types, was not intended by you to read "in alternating current work." 2nd, in measuring to get the voltage of the arc only, of an open arc direct current series lamp, has the term "true watts" any proper place or application in connection with the said measuring to get the voltage of the arc only, in the arc.

Ans.—1st. The reading given in our April issue, of "alternating correct work," was a typographical error, it should have read, as you say, "alternating current work." 2nd. In direct current work, except at the instant of closing or opening a circuit containing self induction, the current and voltage are always in phase with each other, and therefore there is no such a thing as apparent watts or true watts, or rather there is no such a thing as distinction between them, they are the same, and are called simply the watts of the circuit. It follows from this that the voltage at any instant, multiplied by the amperage at that instant, gives you the wattage of the circuit.

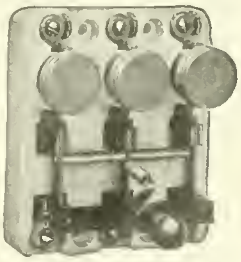
"Subscriber" desires to color some incandescent lamp globes, for decorative purposes, green, red and umber, by dipping into a solution that will leave them transparent and which when dry will not rub off.

Ans: The quickest method is to employ thin spirit lacquer, which may be made by dissolving aniline colors in alcohol, filtering the solutions and adding the same to a solution of gum sandarac in alcohol. For red, use eosine; for green, aniline green; for amber, a mixture of aniline yellow and Bismarck brown. Less than one ounce of these dyes will be required for coloring enough lacquer to dip twenty globes. For preparing sufficient lacquer for the three colors, powder one pound gum sandarac of the pale variety, place in a stoppered bottle with two quarts of 95 per cent. spirit, put in a warm place and shake occasionally, until the gum is dissolved; then add one-half pound clear Venice turpentine and filter. To hasten the solution, the bottle may be placed in a bath of warm water. Divide the resulting solution into three portions, and add to each the previously prepared alcoholic solutions of aniline colors, until the lacquer is of sufficient strength to suit your ideas, which you can readily test by dipping a piece of clear glass into the same. By following this plan you will obviate the use of an oven to dry your globes after dipping and obtain a more brilliant effect than by employing copal varnish.

NEW FORM OF SWITCH.



A very satisfactory form of fused switch has been put on the market by the Canadian General Electric Company, Limited, as shown in the accompanying cuts. It consists of a combination of the well-known punched clip spring switch with the Edison fuse plug. It is designed for 125 volt service, and its use makes the operation of replacing a fuse a safe and simple matter, which can be performed without tools. This feature, combined with the protection which the Edison plug insures, makes this form of switch applicable in many places where other forms of switches could not well be installed. The parts are mounted on a substantial porcelain base, and the device is made with double pole or triple pole single throw switches. The fuse plugs are furnished with any capacity up to and including 30 amperes.



TELEGRAPH and TELEPHONE

OPERATION OF TELEPHONE SYSTEMS.

In a paper read at the Interstate Telephone Convention, Chicago, April 10, 1902, Mr. H. S. Herr, referred as follows to the cost of operating telephone systems :

Very few who are engaged in the independent telephone business knew the expense of operating or the cost of maintenance, even approximately, when they entered into the business, much less did they consider that the expense increased, not only proportionately to the number of subscribers, but in an arithmetic progression. To explain : The expense of operating an exchange of 1,000 subscribers is much more than twice the expense connected with an exchange of 500. At first thought we naturally say that if you can give service to 500 subscribers at $1 per month, you can give service to 1,000 for less. Practice proves just the reverse. The reasons why are many, some of which may be plainly understood by the following :

When there are 500 subscribers connected with an exchange, each subscriber can call up 500 others, and by the time every subscriber calls up every other subscriber there are sent through the exchange 250,000 calls ; when there are 1,000 subscribers and every subscriber calls up every other subscriber once, there are not only twice as many calls sent through the exchange as there were when only the 500 were on the board, but four times as many, making 1,000,000 calls, which is the ratio in increase of the use of the telephone with the increase of subscribers. This requires four times as much labor to take care of 1000 subscribers as it does to take care of 500, and four times as much wear and tear on the apparatus, and much more central machinery or apparatus to do it with. The same is true on outside construction. Consider that the first 500 subscribers are within a radius of one mile from the exchange, with an average of one-half mile of pole lines, and in full metallic circuit, it means one-half mile of wire out and one-half mile in ; the second 500 come within a radius of two miles from the exchange, making an average distance of one and one-half miles for poles and wires, or three half miles out and three miles in, making the amount of construction to reach the outer 500 three times that of the first 500, and four times that required to serve the first 500 will be required to give service to 1,000.

I doubt whether this covers it all when we consider the amount of territory that must be covered by poles and wires as the circle increases. The territory to be covered within a radius of one mile is only a fraction less than four square miles. The territory covered in a radius of two miles is four times that, or sixteen square miles, requiring twelve square miles to be covered with poles and wires to serve the second 500, which, added to the cost of the first 500, would make four times as much pole cost to serve 1,000 subscribers as it requires to serve 500. To serve the out districts the wires can pass over the poles of the first districts, but the poles will have to be much larger and cost more. The amount of cross-arms and wires and insulators is the same as if all the wires were put on separate poles from the central office out.

SHORT-CIRCUITS.

The town council of Gravenhurst, Ont., are considering the installation of a municipal telephone system.

Tenders have just been invited for completing the installation of the telephone system at Gladstone and Plumas, Man.

The Edmonton District Telephone Company, of Edmonton, N. W. T., propose to extend their telephone line from Beaumont to Leduc.

Tenders are invited by the City of Ottawa, Ont., for installing a municipal telephone system, to be ready for operation April 3, 1903, and to be capable of serving 4,000 subscribers.

Mr. H. Locas, of Cheneville, Que., and others, are seeking incorporation as the Telephone Company of LaPetite Nation, to construct a telephone system in the county of Ottawa. The capital stock is $5,000.

The Luther Telephone Company has been organized, with a capital of $1,800, Dr. Campbell, of Grand Valley, Ont., is president of the company. The purpose is to build a telephone line connecting Grand Valley and adjacent villages.

The Canadian Press Association has passed a resolution expressing its approval of the action of the Dominion Government in granting financial assistance towards the establishment of the Marconi system of telegraphy between Great Britain and Canada.

The Parrsboro Shore Telephone Company is extending its operations. The new line from Parrsboro to River Hebert is in operation, and the extension to Amherst will shortly be completed. A telephone exchange is to be established at Parrsboro, which will start with about 50 subscribers. Mr. H. C. Jenks is in charge of construction work for the company. Mr. D. A. Huntley has been elected secretary as successor to Mr. Edward Gillespie.

There are in Canada, according to a statement made in the Dominion Parliament, 55 telephone companies, of which 44 are at present in operation, 25 in Quebec, seven in Ontario, six in Nova Scotia, five in New Brunswick, eight in British Columbia, two in the North-West Territories, and one in Prince Edward Island. The mileage of the Bell Telephone Company is 94,314. The total telephone mileage for the Dominion is 113,294.

Work is progressing rapidly on Marconi's wireless telegraphy station at Glace Bay, C. B. The land upon which the station is being built occupies ten acres. The power house and operating room are situated within a square formed by four towers, which towers are 210 feet apart. The power house is 55x51 feet and the operating room 70x51 feet, both about 20 feet high. The towers will be 210 feet high, tapering from 28 feet square at the base to 10 feet at top. They will be connected at points 70 feet apart by guys of steel wire cable. The force of these cables which is inward will be balanced by similar guys drawing the towers outward at the same point and fasted to anchors surrounding the base in the circle. The contractors for the work are Messrs. Rhodes, Curry & Company, of Amherst.

It has been decided to adopt electric power for the operation of the new C.P.R. shops in Montreal, for which plans are now being prepared. It is probable that the current will be obtained from one of the existing water power companies.

The town of Cornwall, Ont., recently invited tenders for electric lighting, two being received. The Stormont Electric Light & Power Company tendered as follows : Plan No. 1—75 or 80 arc lights, 2,000 c.p., 450 volts, for 5 years, 24½ cents per lamp per night or $89.43 per year ; for 10 years—23½ cents per light, or $85.77 per year ; plan No. 2—26 arc lights and 68 incandescent lights ; 5 years—Arc lights 25 cents per night, or $91.25 per year. Incandescent lights, 32 c. p., $23 per year ; 10 years—Arc lights, 24 cents per night, or $87.60 per year. Incandescent, $22 per year ; plan No. 3—123 incandescent lights, 32 c. p.—5 years, $23 per light ; 10 years, $22 per light. The second tender was from Mr. M. P. Davis and quoted prices for a ten-year contract only, as follows : For 80 arc lights, 30 cents per night, or $109.50 per year, total of $8,760.00 ; for 26 arc lights and 68 32 c. p. incandescent lights, arc lights $109.50 and incandescent lights $29.20 per year, a total of $4,834.60 per year ; for 123 32 c. p. incandescent lights, $29.50 per light, a total of $3,571.60 per year.

ENGINEERING and MECHANICS

THE USE OF STEAM.

In accordance with a resolution passed at the last annual convention of the Canadian Association of Stationary Engineers, the Educational Committee of the Executive are sending out to members a series of instruction papers. The first was on "The Generation of Steam," and the second on "The Use of Steam," the latter being given below:

Steam is a colourless, expansive, invisible fluid, and is produced by heating water or other liquids.

The subjects of steam and heat are therefore very closely connected. We cannot have steam without heat, neither can we have heat without motion, and this is one of its great factors of usefulness to mankind. Our steam engines then are in reality heat engines, and the steam is the medium by which the heat is carried from the coal to completed work at the engine cylinder. We say steam is an expansive fluid; and in this expansion is its great factor of usefulness to us. If we take water at 32 degrees F., and add 180 heat units to it, under our atmospheric pressure it boils, and its temperature is 212 degrees F. Up to this point we can measure the heat with a thermometer, this is called the sensible heat of steam. We also have what is called the Latent (or lost) heat of steam; this cannot be measured by the thermometer and comes about in the following manner:

If we take 1 lb. of water at 32 degrees F. and apply a fixed and known quantity of heat to it until it boils, we will assume that it takes 20 minutes, and we have supplied the water 180 heat units, which, added to the 32 contained in the water at the start makes 212 degrees F. or heat units, and is the sensible heat of steam at atmospheric pressure. Now let us continue the same quantity of heat per minute until all the water has evaporated into steam, we will find it has taken 5⅓ times as long or 107 minutes to do this work. Consequently we have used 5⅓ times 180 or 960 heat units, or to be exact it is 966 heat units. Now the temperature of the steam is the same as the water from which it was evaporated or 212 degrees F., and this 966 heat units is the Latent heat of steam at atmospheric pressure. All steam has a sensible heat corresponding with the temperature of the water it is evaporated from. If you boil water under a pressure of 5 atmospheres or 75 lbs. pressure, the sensible heat is 306 degrees F., the boiling point at that pressure, but the Latent heat has decreased by the same number of heat units that the boiling point increased, so the total is the same in all cases. In the first case we have 212°—32 + 966 or 1146, and in the second case, 306°—32 + 872 = the same, 1146 heat units.

In evaporating our 1 lb. of water under atmospheric pressure, the temperature remained at 212 degrees, but the volume was increased to 1644 times that of water in the second case; evaporating under 75 lbs. pressure the temperature also remained the same, 306 degrees F., but the volume is only 295 times that of the water it was evaporated from. This is one of the reasons it pays to run an automatic cut off engine.

The expansion of steam follows what is called Marriott's Law of expanding gases, which summed up means ½ the pressure doubles the volume. So if we let steam into an engine cylinder at 80 lbs. pressure, and cut it off at ¼ stroke, it is at 80 lbs. up to the point of cut off, at ½ stroke, because it has doubled its volume it is reduced to ½ pressure, or 40 lbs.; while at ¾ stroke the volume has trebled and the pressure has dropped to nearly 27 lbs., and this is why it is economical to run engines that use steam expansively. Steam at 27 lbs. pressure is very much cooler than steam at 80lbs., and this difference in its temperature has been converted into mechanical work by our steam (heat) engine.

Of the Latent heat that disappears in the formation of the steam we can recover a great part of it again when steam returns to water, that is, it gives up its Latent heat when condensed. That is one reason why steam is a good medium to heat our buildings, and also, a good reason why it requires so much cold water to condense the steam back to water quickly as in an engine condenser. Steam also has a very rapid movement. It will flow under a pressure of 1½ atmospheres into the air at a velocity of 67,500 feet per minute, and into a vacuum from a pressure of one atmosphere at the rate of 114,540 feet per minute, or 1,242 feet per second; this is why a steam pipe and the steam ports of a cylinder may have a very much smaller area than the piston itself, and the rate of flow of steam in pipes is how their sizes are determined. The whole science of the intelligent use of steam is to save, utilize, and direct its heat, the more of which we can capture and harness the more money we can save for our employers. The whole success in steam engineering is to stop heat wastes, and the man who can accomplish that the best, is the man with the big salary every time.

All engineers should carefully study the use of exhaust steam. Very nearly 9-10 of all the heat in the steam escapes into the atmosphere from an ordinary engine running non-condensing, and any of this heat that can be put to good use is clear gain. One of the first uses to put the steam to is the heating of feed water for the boiler; another is to heat water for any other purpose about the building or factory. Still another is to heat dry kilns of different kinds, and also the heating of the buildings. All of these things can be accomplished without adding more than 1 or 2 lbs. to the atmospheric pressure, against which all non-condensing engine pistons move. In the heating of feed water each 10 degrees F. added to it will save 1 per cent. of fuel —and if your feed water enters the boiler at say 40 degrees F., and you bring it up to 212 degrees F. by the use of exhaust steam, you have still left in the steam 966—212 = 754 heat units that may be used for other purposes. In heating your feed water from 40 to 212 degrees you have only condensed 2-11 of the steam used for that purpose. An economical 80 h. p. automatic cut-off engine using 30 lbs. steam per h. p. per hour, and discharging into the atmosphere at a back pressure of 1 lb. per square inch, will discharge heat enough to supply 9,000 square feet of radiating surface, or enough to heat a building containing 720,000 cubic feet of space.

What per cent. of fuel will you gain if you heat the feed water from 60 degrees to 210 degrees by the exhaust steam or other waste heat, the steam pressure being 60 lbs.?

By your steam tables you will find the sensible heat of steam at 60 lbs. pressure to be 30.7, and the latent heat will be 899, making the total heat units 307 + 899 = 1,206. The total heat supplied per lb. of steam is 1,206—60 = 1,146, but the feed water increases in temperature from 60 to 210, a gain in heat of 150 degrees. Therefore we have $\frac{150 \times 100}{1,146} = 13.86\%$

Rule.—Divide 100 times the difference between the final and the initial temperatures by the total heat units in the steam, minus the initial temperature of the feed water; or the formula will be thus:

$$100 \left\{ \frac{\text{Final temp. of feed—initial temp. of feed.}}{\text{Total heat units in steam—initial temp. feed water.}} \right.$$

Example—Initial temperature of feed water is 45 degrees, final temperature 210 degrees, steam pressure 100 lbs. gauge. Find the gain. Ans.—14.1%.

ENGINEERING NOTES.

About two hundred engineers have applied for examination this spring under the Steam Boilers' Inspection Act of British Columbia. Mr. John Peck, of New Westminster, is chief inspector for the province.

A bill was introduced in the British Columbia Legislature last month to amend the Steam Boilers' Inspection act, providing that an engineer with a certificate of service, series 2, given without examination, shall be qualified to take charge of the steam plant mentioned on the face of his certificate. After considerable discussion the amendment was passed.

The Montreal branch C.A.S.E. elected the following officers last month: President, M. R. Marchand; 1st vice-president, E. Valiquette; 2nd vice-president, F. H. Lavigne; recording-secretary, Alex. Belair; financial secretary, A. Leprohon; treasurer, E. Boyer; introductor, T. Leclair; door-keeper, O. Fontaine; trustees, Achille Leprohon, E. Brisebois, R. Drouin; executive board, R. Drouin, R. Marchand, J. Hartenstein; promoter of education, E. Valiquette.

CLARKSON SCHOOL OF TECHNOLOGY.

Mr. William S. Aldrich, director of the Clarkson School of Technology, Potsdam, N.Y., has sent us a list of subjects for graduating theses for June, 1902. The subjects serve to indicate the character of the work carried on in this institution. They are as follows: "Development of the Water Power of High Falls on Deer River"; "A Study of the Possibilities of the Development of Water Power on the Indian River"; "A Design for a Power Plant on the Indian River"; "Investigation of the Properties of Liquid Condensers"; "Influence of Chemical Composition on the Electric Conductivity of Wrought Iron and Soft Steels"; "Performance of a Motor Generator Set vs. a Rotary Converter of the same capacity"; "The Design, Construction and Performance of an Experimental Polyphase Transmission Line"; "An Experimental Study of a Single-phase Induction Motor"; "Installation of, and Experiments on, a 15 H. P. Otto Gas Engine"; "Experiments on the Flow of Steam through Rectangular Orifices"; "Design of a Compound Marine Engine."

SUCCESSFUL McGILL STUDENTS.

The following students were successful in the course of electrical engineering at the spring examinations of McGill University, Montreal: Frederick S. McCloskey, Boiestown, N. B.; George H. Cole, Ottawa, Ont.; George K. McDougall, Montreal, Que.; John H. Cardew, Young's Point, South Beach, Ont.; Louis H. Narcotte, Westmunt, Que.; John A. Wenger, Ayton, Ont.; Myles H. Roffeym, Braintreem, Essex, England; Cecil G. Devlin, Mohawk, Ont.; Moses A. Fullington, Newport, Vt.; Oswald A. Mundy, Hamilton, Ont.; Ernest A. Piche, Montreal, Que.

TRADE NOTES.

Babcock & Wilcox, Limited, Montreal, have removed their offices to the New York Life Building.

The Robb Engineering Company, Amherst, N. S., are supplying two boilers for heating and power purposes to be installed in the new Strathcona apartment building in Winnipeg.

We have received an attractive catalogoue of small motors for sale by the Canadian General Electric Company, who report an increasing demand not only for motors for use with direct current, but also for small motors for alternating current circuits.

The Pittsburg Transformer Company, of Pittsburg, Pa., devote that energy and capital exclusively to the manufacture of transformers. This company was organized in 1897 and has been compelled to frequently enlarge their plant. Their transformers were awarded a bronze medal at the Paris Exposition of 1900.

The Pittsburg Transformer Company, of Pittsburg, Pa., is shipping its specialties to Kopmann & Co., of Amsterdam, Holland, through its managers for foreign sales, the Goudey-McLean Company, of 88 Maiden Lane, New York City. The Pittsburg concern has opened a New York office under the management of A. H. Mustard, formerly of the Wagner Electric Manufacturing Company. The new office is located in the Beard Building, 120 Liberty Street.

The Packard Electric Company, of St. Catharines, Ont., have secured the exclusive Canadian manufacturing and selling agencies for the Hylo turn-down lamp. This lamp has two filaments, one being of the usual size, giving 16 or 18 candle power, the other being exceedingly small and giving only a one-candle power light. The slightest turn of the lamp will extinguish the large filament and light the small one. By this means a saving is effected of five-sixths of the current ordinarily consumed. The two filaments of the Hylo lamp have a combined life of 4,000 hours, 1,000 for the big filament and 3,000 for the "Baby" filament, giving to the Hylo a life claimed to be three times that of an ordinary 16 candle power lamp.

The bill of the Ontario Power Company, which proposes to transmit power from Niagara Falls to Toronto, was defeated in the Private Bill Committee of the Dominion Parliament last month.

The tender of the Canadian Heine Safety Boiler Company, of Toronto, has been accepted for furnishing three boilers for the Toronto waterworks. The price is $11,231. There were two other tenderers. The old boilers have been sold for $270.

SPARKS.

Mr. W. K. Vanderbilt, jr., is said to have made a remarkable performance with a motor car, covering the distance from Monte Carlo to Paris, 644 miles, in 17 hours.

Mr. C. H. Mitchell, C. E., of Niagara Falls, Ont., is superintending the construction of the new power house for the Niagara, St. Catharines & Toronto Railway Company at Merritton.

Messrs. E. J. Philip, G. W. Grant, T. H. Hamilton, and T. D. Lovering have been incorporated as the Dominion Motor & Machine Company of Toronto, with capital of $40, 000, to manufacture automobiles, gasoline engines, etc.

Mr. Norman Smith, E. E., has presented to the council of Toronto Junction, Ont., a report on electric lighting. It was divided into three parts. Report No. 1 suggested that the town discard the present dynamo and lamps and purchase new ones, at a cost of $6,166. The second report suggested that the present boiler, dynamo and series lamps be discarded, and that there be installed a new boiler, an alternating current generator, and 35 new arc lamps, at a cost of $7,495. With this plant there would be an additional cost of $2,000 for transformers and meters. Report No. 3 suggested that in addition to the apparatus recommended in No. 2, there be installed a new engine at cost of $2,300, a boiler at cost of $1,425, generator and switchboard at cost of $2,700, and other necessaries at cost of $820. The report is under consideration by the council.

The Lachine Rapids Hydraulic & Land Company, of Montreal, have been awarded the contract for street lighting by the municipality of St. Cunegonde, Que., the price being $90 per lamp per year. Since 1892 the Royal Electric Company has been lighting the streets at $100 per lamp per year, and the company offered to renew its contract, which expires May 1st, at $88.40 per light, but the council decided that a fifty year franchise, which was granted to Mr. Robert Bickerdike in 1892, and subsequently transferred to the Lachine Company, to begin this year, was to be observed, hence the award. This means that the Lachine Company has a fifty-year contract, but there is a clause that the rates for street lighting shall be determined by arbitration every ten years, and that private consumers shall be provided with power and light at the rates current in the city of Montreal.

Mr. A. L. Boucher, electrician, employed by O'Reilly & Murphy, Ottawa, states that he will shortly place before the public a new heating device which for intensity of heat and melting power will show some startling developments. He claims that the hardest substances, such as cast steel, etc., will readily melt and flow even when placed at a distance of 9 inches from the machine. During the first experiments he contends that an ordinary Fahrenheit thermometer of 212 degrees was used to register the amount of heat obtained from the machine, but with current applied the result was that the glass part was instantly reduced to liquid form. During the next experiment a centigrade thermometer of 512 degrees replaced the Fahrenheit, but fared the same and quickly melted before the intense heat. Next a bar of cast steel was employed, but even this, hard as it is, was not proof against the remarkable qualities of the new discovery, but melted like wax before a flame. This would go to show that to accomplish this result a temperature of 2,520 degrees was required, being the fushion of steel, or heat at which this metal will melt.

PUBLICATIONS.

A second edition of a popular exposition of wireless telegraphy by C. W. de Tunzelmann, B.Sc., etc., has recently been issued by the publishers of "Knowledge", 326 High Halborn, London; price 1s 6d. The book, which comprises 100 cloth bound pages, records the historical development of wireless telegraphy and describes the means by which some knowledge may be obtained about the physical facts upon which the practice of etheric telegraphy is based.

We have received a copy of the first issue of the American Electric and Automobile Patents Monthly, published by the American Patents Publishing Company, of Washington, D. C. The purpose of this journal is to publish full drawings and descriptions of all patents relating to the electric and automobile industry, as well as air and gas engines. The services of Mr. James T. Allen, of the United States Patent Office, have been secured as compiler of the magazine. The subscription price is $5 per annum.

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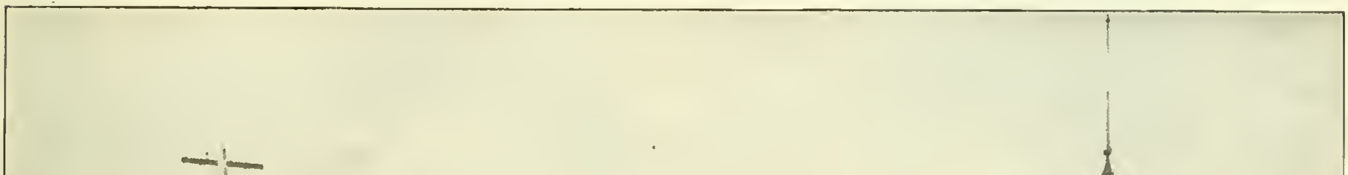
Canadian Electrical Association

THE TWELFTH CONVENTION TO BE HELD IN HISTORIC QUEBEC

THE Ancient City of Quebec is to be the meeting place this year of the Canadian Electrical Association. The convention will occupy four days, opening on the 11th and closing on the 14th inst. The programme, printed elsewhere in this number, is an interesting one. Coupled with the many attractions of the Convention City, it should draw forth an unusually large attendance of the members.

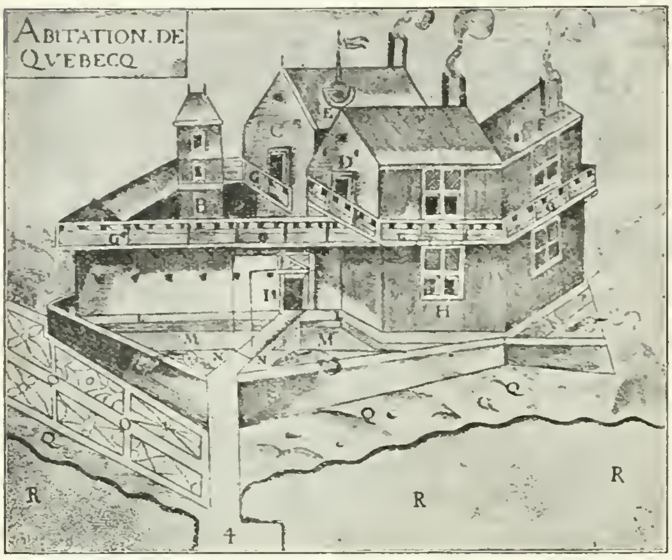


City Hall, Quebec, where the Business Sessions of the C. E. A. Convention will be Held.

Quebec vies with Niagara Falls as being one of the most interesting places on this continent and is visited every year by thousands of tourists from all parts of the world. Nowhere else on this side of the Atlantic is to be seen such interesting mediaeval remains side by side with such up-to-date features as electric cars, and an abundance of electric light and power. Nothing can stand in the way of modern progress, hence some of the old landmarks have disappeared, but there remain enough to awaken and gratify the deepest interest of the visitor. Those who have never seen Quebec should not forego the opportunity of doing so under the particularly favorable conditions afforded by the coming meeting of the Canadian Electrical Association, when every facility will be placed at the disposal of visitors. Those who, by previous visits, already know something of the charm of the place, will be certain to try to pay it another visit.

The ancient city of Quebec was founded by Champlain in 1608, and remained under French rule until 1759. On the 13th of September of that year was fought the renowned battle between the French and the

British in which both commading generals were slain on the field, the British finally being victorious and resulting in Canada's cession to England. Monuments to the memories of both Wolfe and Montcalm have been erected. The British immediately turned their attention to the defence of the city, and from its commanding position and the strength of the fortifications since constructed, it has been not inaptly termed the "Gibraltar of America".



Quebec in 1608, from Drawing by Champlain.

The view of the city, as approached from the river, is singularly impressive. The fortifiations, with their towers and battlements, frown upon the visitor from the Plains of Abraham and from the Lower Town, and there surrounds the place an air of mediaevalism which is at once novel and attractive.

The city consists of two divisions, known as the Upper and Lower Towns. The Upper Town includes within its limits the Citadel of Cape Diamond, which covers the entire summit of the promontory, embracing an area of more than forty acres. It rises to a height of 345 feet above the level of the river. The view from the citadel, owing to its great elevation, is surpassingly grand and comprehensive. The majestic St. Lawrence, alive with sailing craft of every kind, stretches before the vision in both directions. Directly below lie the crooked streets of the Lower Town. To the east are the Plains of Abraham, together with the bluffs scaled by Wolfe and his brave soldiers in the preparation for the assault that ended in victory.

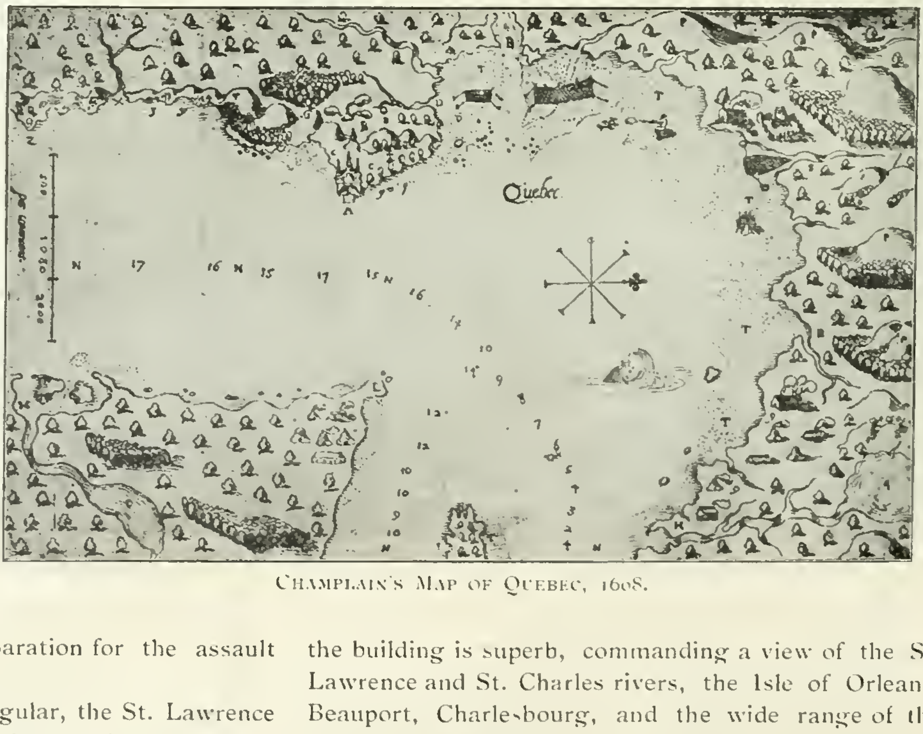
The shape of the city is triangular, the St. Lawrence and St. Charles rivers forming the two sides, with the Plains of Abraham as the base. The river fronts are defended by a continuous wall on the very brow of the cliff, with flanking towers and bastions, loop-holed for musketry and pierced for cannon. On the west side a heavy triple wall, with trenches between, formerly guarded that approach, but much of it is now demolished. The numerous ancient gates, churches, colleges, and public buildings of interesting architecture, pretty private residences, together with other features of interest, give the city a distinction which is bound to entertain and please the visitor.

The surroundings of Quebec are equally as attractive as the city proper. Directly across the river is the city of Point Levis. The Isle of Orleans, a few miles distant, may be reached by ferry, and affords delightful drives. Perhaps the most interesting point is the Falls of Montmorency. The river of that name was the scene of the battle of Montmorency, which immediately preceded Wolfe's final victory at Quebec. At the falls the water pours over the cliff into the St. Lawrence, a depth of 250 feet, broadening at the edge to about 50 feet. It is here that the famous shrine of St. Anne is located.

There are numerous water falls of magnificent power near the city of Quebec. It is probable that an invitation will be extended by the Great Northern Railway Company to the delegates to the convention to inspect the power development at Shawinigan Falls, of which an illustration is shown on another page.

PUBLIC AND PRIVATE BUILDINGS.

Located on the site of the venerable Jesuit barracks is the new city hall, an imposing structure of fine architectural proportions, and built of solid masonry designed to last for ages. Facing the Basilica, it is a substantial ornament to the central business locality in Upper Town. The Court House, in its location at Louis street and the Place d'Armes, presents a fine appearance. The Parliament Building on Grande Allee is a noble provincial structure of French seventeenth century style, in the form of a quadrangle. The site of the building is superb, commanding a view of the St. Lawrence and St. Charles rivers, the Isle of Orleans, Beauport, Charlesbourg, and the wide range of the Laurentian Mountains in the distance.



Champlain's Map of Quebec, 1608.

Quebec is well endowed with colleges, churches, etc. The Basilica at once commands the attention and admiration of the visitor. The Grand and Petit Seminaries, Laval University, Morrin College, the Convents

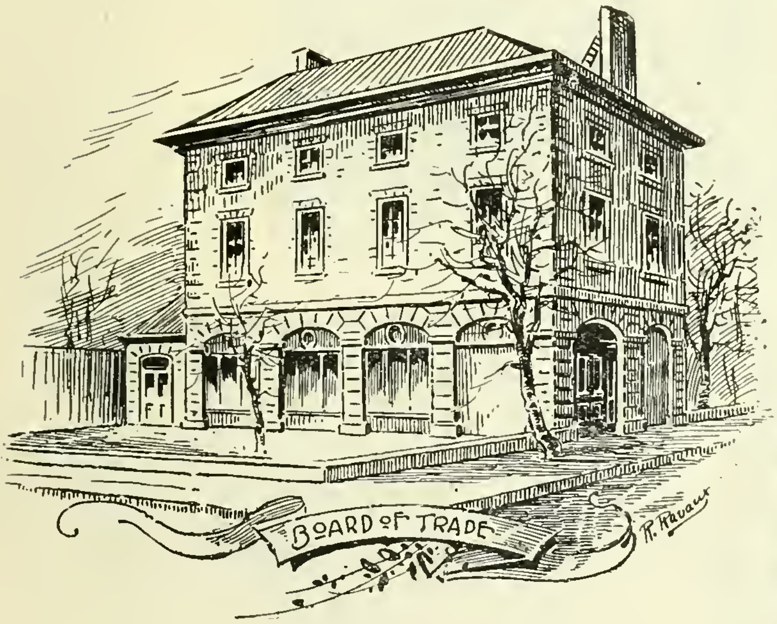
Bridge in Course of Construction Across the St. Lawrence River at Quebec.

of St. Ursuline and Good Shepherd, and St. Sauveur and St. John's churches are noble seats of religious instruction and educational culture. First, perhaps, among the Protestant churches is the English Cathedral.

It must not be supposed that Quebec does not possess business establishments of first rank. This article, however, is concerned most with that which interests the pleasure seeker. A visit to the timber coves would convey an excellent impression of the shipping trade of the port.

THE QUEBEC BRIDGE.

An interesting engineering work is the Quebec bridge, now in course of construction across the St. Lawrence river about six miles west of the city. The site of the bridge is the narrowest portion of the river between Montreal and Quebec. The river at this point flows between high rocky cliffs, the waterway being about 1,900 feet at low tide and 2,500 feet at extreme high tide, the tidal rise varying from a minimum of 14 feet to a maximum of 20 feet. The channel is crossed with a suspended span and two cantilever arms, making an unsupported structure 1,800 feet long between centre and main piers, which is the longest span in the world. The length of anchor arms on each side of the main span is 500 feet, with one approach span of 220 feet at each end between anchor piers and terminal abutments. The total length of the structure, including abutments, is 3,300 feet.



Board of Trade, Quebec.

The substructure consists of two main piers, two anchor piers, and two abutments. The north anchor pier is founded on solid rock, commonly called sillery of hard blue clay about 85 feet in thickness, containing large boulders. Both piers are of granite, backed with grit. The south anchor pier is founded on a formation concrete, 105 feet long by 24 feet wide at coping, and by 30 feet by 111 feet at the base, and 56 feet high from bottom of anchorage to coping or base of steel towers.

Kent Gate, Quebec.

Entrance to the Citadel, Quebec.

Champlain Monument, Quebec, Erected in 1898.

Montcalm's Monument.

Monument to the Braves.

Wole's Monument.

THE QUEBEC RAILWAY, LIGHT AND POWER COMPANY.

Of the many falls in the province of Quebec, perhaps the grandest as well as the most picturesque are those on the Montmorency. Indeed, in many persons' estimation they outrival even mighty Niagara. This is due to the fact that the water is dissembled just at the very brink and falls in one mass of white, foaming spray no less than 267 feet to the rock bottom beneath, its mad career being there checked in the peaceful bosom of the mighty St. Lawrence.

Inasmuch as these falls are only seven miles distant from the city of Quebec, one would necessarily expect to find that they had at some early date been used for industrial purposes. Such is the case, for many years ago the river was dammed up some distance from the falls, and power was supplied to run a large sawmill, the lumber trade then being and still remaining one of the chief industries of Quebec. This had its day, and gave place to the Quebec & Levis Electric Light Company, which built a dam close to the falls, and by means of a wooden flume supplied water to its power house situated under the bluff, near the river side.

The Montmorency Electric Power Company, Limited, then came into existence, absorbed the old company and started a radical change, and later this company was absorbed by the Quebec Railway Light & Power Company, who carried out the changes. Meantime a cotton mill had been established at the foot of the falls, and water power to the extent of 1,000 h. p. and electricity to the extent of 600 h. p. to run its machinery is furnished in a manner as unique as it is satisfactory. This is nothing more or less than by using the remaining potential energy of the discharge water from the present power house, which is situated some little distance above the mills.

THE HYDRAULIC DEVELOPMENT.

To return, in the gradual change that has come about, an immense concrete dam has been built about 100 feet from the very brink of the falls. By referring to Fig. 1, the dam with the water rushing over its crest may be seen extending from bank to bank, a distance of 265 feet being the maximum. At the left hand of the dam is the gate house, a small wooden building, from the upper corner of which is a wing dam extending up stream 325 feet, enclosing on its shore side the head race, a body of calm, clear water. This wing dam is built of cribwork varying from 8 feet wide at the top to 20 feet at the bottom, the timbers in its construction being from 9 to 14 inches square, small granite rock filling up the spaces. Along the river bottom of this wing dam are seven apertures, varying from 12 to 20 feet in width, all being about 7 feet high. By this means all floating rubbish is prevented from entering the head race. This dam was also built to get rid of frazil ice, that bugbear to Canadian water-power development.

Frazil, that is, fine, needle-like crystals of ice, forms only in rapidly flowing water, where it has no opportunity of adhering and forming surface ice. During very cold weather some of the rapidly flowing streams become full of it, even to the consistency of thick pea soup, and should this touch any sufficiently cold body it will immediately adhere, and in a very short time form a small sized iceberg extending almost to the very bottom of the stream. The manner in which this wing dam carries off this frazil is as follows : The swift current of the river sweeps all the frazil down stream over the dam, none passing through the apertures in the cribwork on account of there being not sufficient current there to cause it to enter. Although the current is very slow, it is not still, because there must be the same amount of water enter the head race as flows out through the pipe. This plan has been so successful that it has not been necessary to close down for an instant on account of frazil.

The entrance to the intake is in the gate house, and is protected by a heavy iron bar rack, which keeps it free from all rubbish. The intake pipe is of iron, 9 feet in diameter, reducing down to 8 feet, which is the size of the upper end of the pipe line. The heavy gate to open or stop the flow of water in the pipe is operated in the gate house by means of a rack and reducing gear. There is another gate by which a sluice in the dam may be opened if it is required at any time to lower the level of the water in the dam. The feeder pipes necessarily contain many bends, as the hillside is steep and by no means regular. The pipe is of tank steel, 2,609 feet long from the dam to the power house. It was found necessary to make some provision for the protection of the pipes from the changes in the volume of water flowing due to the opening and closing of the turbine gates, as the load on the generators should change.

It is not only for the protection of the pipe that this oscillation should be obviated, but also to allow the governors to regulate the changes of load on the generators only, and not to be affected by the fluctuation of water, the latter being a very important consideration in all water power plants where a steady service is required. It was considered that stand pipes would be superior to relief valves, and would remedy these faults. Two stand pipes were therefore erected, one being placed immediately outside of the power house, the foundation being 75 feet above the house, and the pipe 150 feet high. It is housed from top to bottom with a four-inch air space to prevent freezing.

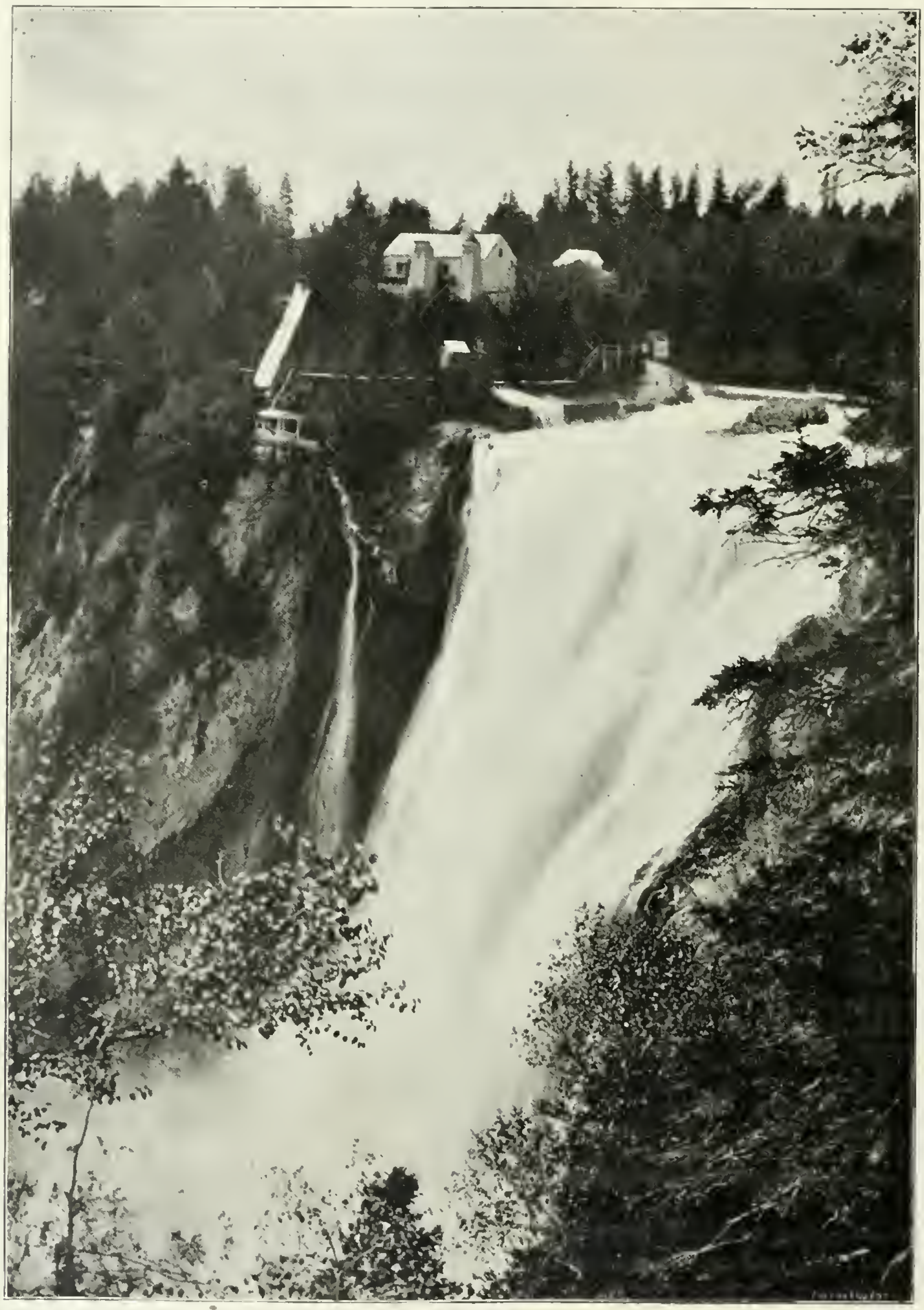


FIG. 1, QUEBEC RAILWAY, LIGHT AND POWER COMPANY—MONTMORENCY FALLS.

The other stand pipe is erected midway between the dam and the power house. It is 45 feet high, and has a counter fluctuation effect on the action of the stand pipe located lower down. It is believed that this plan has much to do with the successful engineering of this important installation.

The power house is a stone structure of two stories, 40 feet wide by 150 feet long. The turbines are called the Victor high pressure wheel, and were built by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. There are five units in the plant, each having a capacity of 1,000 h. p. under a head of water 200 feet high. The wheel shaft is coupled direct to the generator shaft with flange couplings and fiber plate and bolt bushings to insure perfect insulation. For regulating the variation of speed of wheels and generators due to change of load, there is attached to each turbine a Giesler mechanical-electrical governor. At the official test made by the engineers appointed by the Quebec Railway, Light & Power Company, the turbine at half gate gave an undisputed efficiency of 78 per cent.

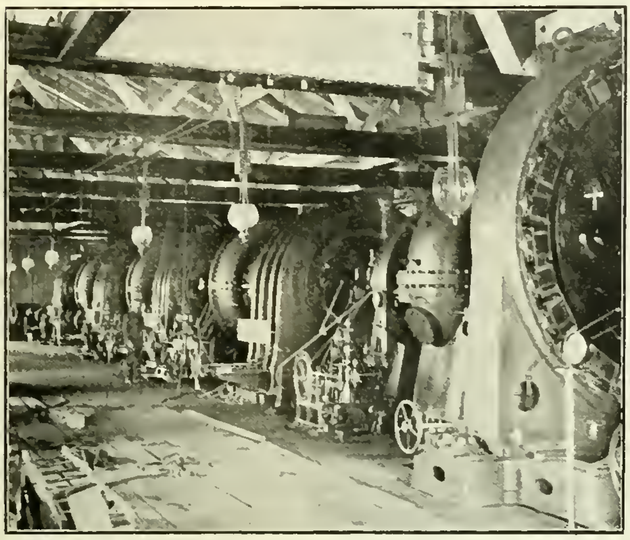


Fig. 2, Quebec Railway, Light and Power Company—Generators.

THE GENERATORS.

There are three 600 k.w. and one 720 k.w. two-phase S.K.C. alternators delivering current at a frequency of 66 cycles per second direct to the line at a pressure of about 5500 volts. It might be interesting to note that three of these machines were the first of that style to be manufactured by the Stanley Manufacturing Company at Pittsfield, and they have not cost one cent for repairs during their six years' operation. The other machine was built by the Royal Electric Company of Montreal, from a similar design (Fig. 2).

The fifth unit is a Westinghouse generator delivering direct current at 550 volts from one end, and two-phase alternating current from the other end. The D. C. current is used on the St. Annes Railway, which passes the power house, and the alternating current is transformed from 480 volts two-phase to 11,000 volts three-phase, and transmitted to a sub-station at St. Annes de Beaupre, where it is transformed from 11,000 volts three-phase to 385 volts two-phase, and by means of a Westinghouse 200 k. w. rotary converted to 550 volts D.C. on to the trolley of the St. Annes railway, (Fig. 3).

There are two D.C. generators separately driven for excitation purposes. The switchboard is composed of three white marble panels with polished hardwood frame. Each panel is divided into three sub-panels. On this switchboard are situated all the instruments and rheostats for regulating the machines. Here is a voltmeter indicating the voltage at the sub-station, pressure wires being run all the way back to the power house for this purpose. The primary voltage of the machines is regulated to obtain the correct reading on this voltmeter.

There are two pole lines, seven miles in length, for the sixteen wires necessary for the four 4-wire two-phase machines, on account of their not being connected in multiple at the power house. This was found to be the only satisfactory method of obtaining a perfectly uniform light in the city, as it was then independent of the greatly varying street railway load. The wires pass through a slate panel in each cupola, by means of a porcelain tubing, to the two pole lines. They are No. 0 medium drawn bare copper wires, 18 inches apart, four on each cross-arm. The two lines of eight wires each run parallel for some distance, about 100 feet apart, then branch off, and after following widely divergent lines finally converge and unite into one pole line at the bridge crossing the St. Charles river. As this river is navigable above the bridge, provision had to be made for either tunneling under the river or crossing the bridge at such a height as to clear the masts of any passing ships. The latter was decided on, and for this purpose two iron towers were built, 140 feet high, across which the wires are strung, the span being 50 feet. On account of the high winds, the distance between wires was increased to 21 inches.

The poles vary from 50 to 55 feet in height and are spaced 90 feet apart. Two barbed wires on the outside edges of the upper cross-arms, grounded at every fifth pole, together with banks of lightning arresters at each end of the line, protect against lightning.

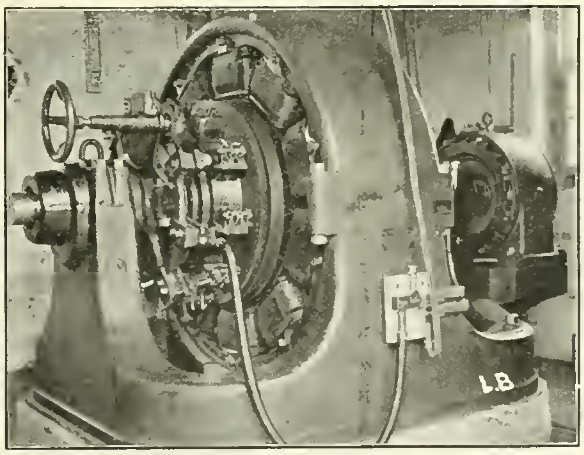


Fig. 3, Quebec Railway, Light and Power Company—Rotary Converter.

THE SUB-STATION.

Situated on Prince Edward street, in Quebec, Lower Town, near the river St. Charles, a tributary of the St. Lawrence, is the sub-station, a handsome two-storey native limestone structure. The equipment consists of 14 100-k.w. single phase Stanley transformers, ten of them being immersed in mineral oil in a cylindrical iron case and cooled by water circulation through pipes inside the case, the remaining four being also placed in cylindrical iron cases, but only cooled by air. The water for these transformers is obtained from an artesian well sunk in the cellar 26 feet deep, from which water is pumped by means of a single-acting pump driven by a 2 h.p. belt-connected two-phase motor.

The transformers reduce the line voltage from 5,000 to 2,000 volts and may be connected in banks of three in multiple or each separately on each phase by means of the transformer switchboard. The transformers are situated in a locked room on the ground floor by themselves. On the same floor are two motor generators, two synchronous motors direct-connected to four 125-light Brush multi-circuit arc machines, and two Bullock exciters direct connected to two induction motors. These motor generators are two separate machines on separate basis, but direct-connected by means of an insulating leather coupling.

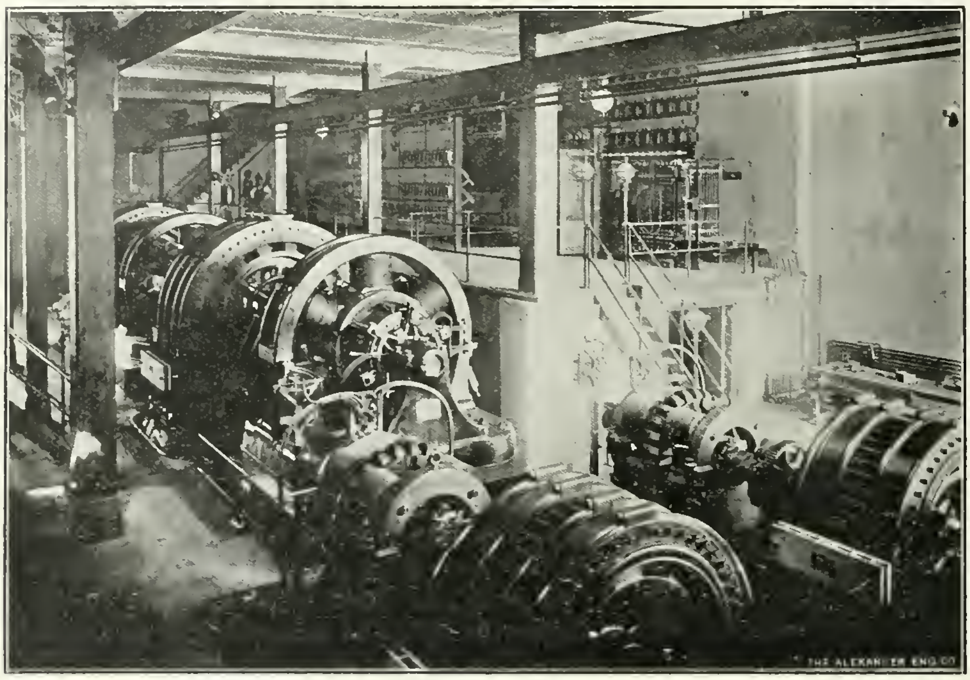


FIG. 4, QUEBEC RAILWAY, LIGHT AND POWER CO.—RAILWAY GENERATORS IN SUB-STATION.

The alternating side is a 600 k. w. two-phase S. K. C. synchronous motor taking current at a frequency of 66 direct from the line at a pressure of 5,000 volts and running at 286 r.p.m. The direct current side is a General Electric 6-pole 450-k. w. generator delivering current to the street railway at a pressure of 550 volts (Fig. 4) To start this machine and bring it up to the speed of synchronism, a 30 h.p. 1000 volt, two-phase S.K.C. induction motor is used, which gears with a spur wheel on the synchronous motor shaft. When in synchronism this gearing is disengaged by means of an eccentric which throws the whole motor and gear wheel away from the synchronous motor.

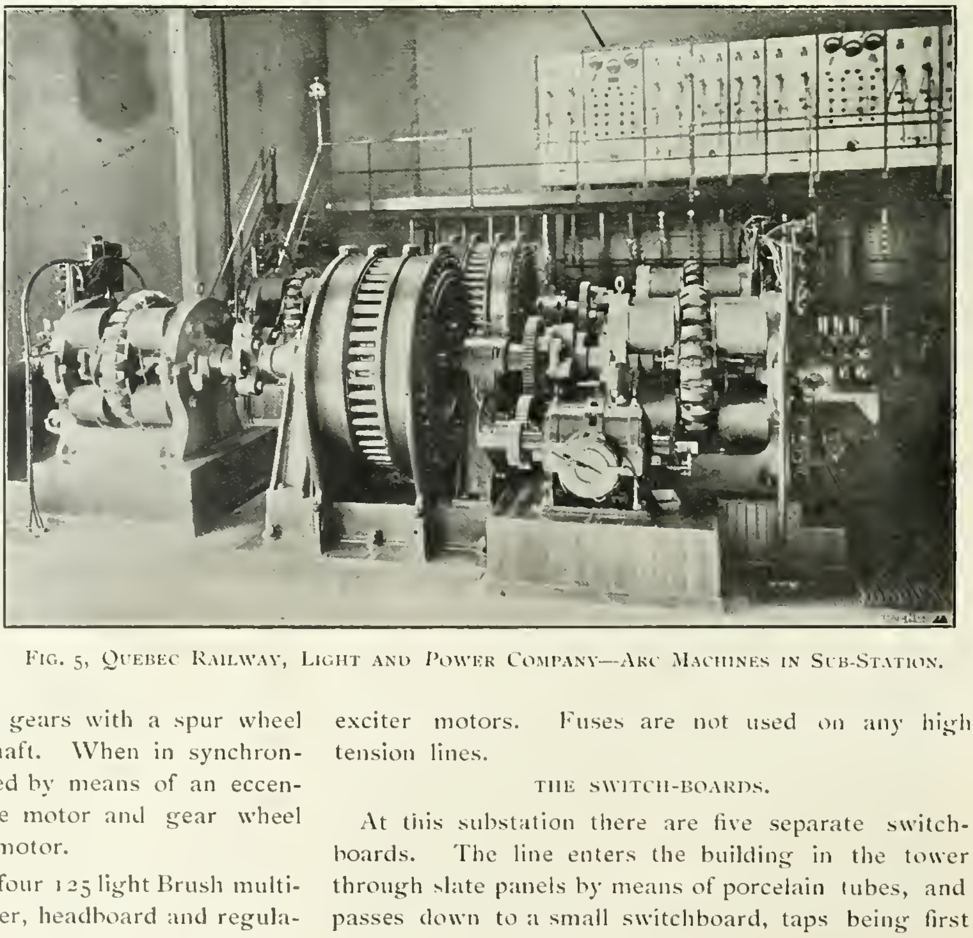


FIG. 5, QUEBEC RAILWAY, LIGHT AND POWER COMPANY—ARC MACHINES IN SUB-STATION.

For arc lighting there are four 125 light Brush multi-circuit arc machines. Ammeter, headboard and regulator are placed on the machines themselves. These are driven by two 200-k.w. two-phase S.K.C. synchronous motors at a speed of 500 r.p.m., the motors taking current direct from the line at a pressure of 5,000 volts. Each motor is placed between two arc machines and direct connected to them by means of two insulating leather coverings, one on each side, as can be seen in the illustration Fig. 5. Each machine is brought up to synchronism by means of a 15 h.p. two-phase 1,000 volt S. K. C. induction motor geared to the shaft of the synchronous motor, after which the induction motor is disengaged in a similar manner as to that previously described.

For exciting the fields of the synchronous motors two 30-kw 75-volt multipolar Bullock machines directly coupled to two 30-kw two-phase 1,000 volt S.K.C. induction motors are used. Either one of these exciters is sufficient for all four synchronous motors, and also for another 600-kw unit to be installed. This makes a duplicate exciting plant.

There are six Stanley transformers situated under one of the switchboard galleries, reducing the line voltage to 1,000 for the four starting and the two exciter motors. Fuses are not used on any high tension lines.

THE SWITCH-BOARDS.

At this substation there are five separate switchboards. The line enters the building in the tower through slate panels by means of porcelain tubes, and passes down to a small switchboard, taps being first taken off every line to lighting arresters of the Wurts non-arcing low equivalent type. Here they are put into multiple with two rows of switches, the upper ones, four double-pole four-point break high tension S.K.C. switches of the slide type connecting to the transformer board ; the lower ones are merely plugs not intended to break the circuit, but simply to connect the line to another high tension switchboard for placing any line on the synchronous motor busses.

On each panel of the transformer switchboard, which is constructed of six panels of white marble with a polished hardwood frame, there are two transfer boards, one in order to connect any primary circuit to any transformer, and one to connect the secondaries to any set of bus-bars. This transfer board is of the socket and connecting plug type previously described. Besides the transfer boards there are also two switches on each panel, the upper being a double-pole four-point break 2,000 volt switch, the lower a four-pole eight-point break with two contacts on each side in multiple, for breaking the 5,000 volt primary connections to the transformers. These switches are all of the slide type, made by the Royal Electric Company, Montreal, for the S.K.C. system.

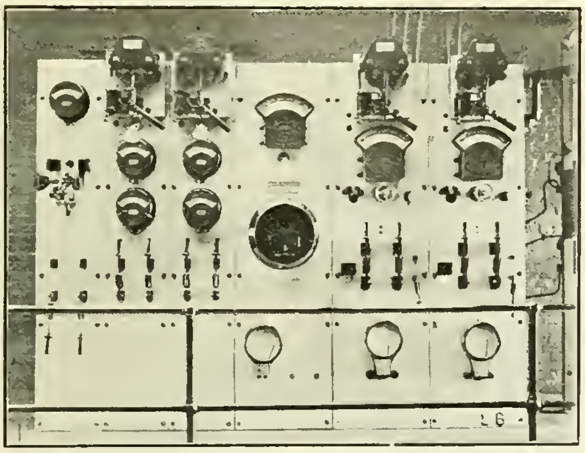


Fig. 6, Quebec Railway, Light and Power Company—Switchboard.

From the transformer board the secondaries run to a main switchboard on a gallery over the transformer room, a view which is given in Fig. 4. It consists of six white marble panels on a polished hardwood frame, each panel being again divided into three sub-panels. The panels on the left are for incandescent lighting only, the two on the right for power only, while the two middle ones are main and indicating panels. There are four pole double-throw switches on the middle panels to connect any machine on either the lighting or power bus-bars. Above these are situated all the ammeters and voltmeters for indicating the load and voltage. These are all of the Whitney type.

On the two lighting panels are three rows of eight double-pole double-throw switches, one for each city feeder, by means of which any circuit may be thrown on any bus-bars. At the top of the board are 8 Stanley double-pole circuit-breakers, one on each distributing circuit. The power side of the switchboard is a repetition of the lighting side, except that all the switches and circuit breakers are four pole instead of double pole.

There is also delivered to this switchboard 1,000 h. p. by the Canadian Electric Light Company from their Chaudiere power house, by way of a step-down transformer station at Levis and by cable under the St. Lawrence river.

On a gallery on the opposite side of the sub-station are situated two switchboards, one for controlling the four synchronous motors and their starting motors, and the other the street railway board. The former is a long board of 20 white marble panels with polished hardwood frame. On this board there are five panels necessary for each synchronous motor and its starting motor. Part of this board may be seen in Fig. 5, showing the arc machines. The second panel of each set of five is a transfer board having sockets and connecting plugs for placing the synchronous motor on any one of the four lines. On the upper part of the panel there are three ammeters for measuring the current on each phase delivered to the synchronous motor, and the field current.

On the lower sub-panel is the field rheostat. The first and third panels contain the main 5,000 volt switches, of the bayonet stick type, for connecting the line to one of the synchronous motors. The lower sub-panel of the first contains the synchronizing lamps and switch, while similarily situated on the third panel is a double-pole double-throw switch for exciting the fields from either of the two exciters. For synchronizing purposes one lamp only is required, but as the machines are coupled when the lamp is bright, two other lamps are placed alongside always lighted to prevent accidents, which might occur should one of the main connections be broken, in which case the synchronizing lamp would be bright and remain so. The fourth and fifth panels of each set contain the four 1,000 volt switches, also of the bayonet stick type, for the starting two phase induction motor.

Situated at the opposite end of the same gallery is the railway switchboard, Fig. 6, of six panels, also of white marble. It is practically the standard General Electric railway type, with perhaps the distinctive feature of containing a Thomson intergrating wattmeter to measure the power taken by the street railway. There are also Bristol recording instruments showing the voltage and output. The frame work under these switchboards is of iron I beams on which a slate floor is laid, while for further protection a rubber mat covers the slate floor. The railing extending the length of the boards is also insulated from the ground.

Returning to the opposite side of the station the arc light switchboard is situated at the end of the gallery, shown in Fig. 4. It is of the Brush type, built of enameled slate with connections for 12 circuits. Incandescent pilot lamps are placed immediately over the switchboard, while in the intervening space between these and the ceiling are Thomson magnetic blowout lightning arresters. A 20-ton hand crane runs the whole length of the station. All machine leads and high tension lines crossing the interior are placed in ducts in the floor, covered with neat iron plates.

Not many years ago any one who had prophesied that a street railway would be operated in Quebec would have been laughed at ; nevertheless in spite of many difficulties, arising from the heavy grades encountered in rising from lower to upper town, the narrow and crooked streets and the severe climatic conditions, the railway is operating very successfully. Sixteen miles of single and double track have been laid.

The heaviest grade is one of 15¼ per cent., with a 40-ft. radius curve at the top half, the curve being on the hill itself. Curves of 35 ft. radius are quite common, while in some places it is necessary to use a reverse curve to turn a corner. A heavy grade has been overcome in one out-of-the-way place by building steel trestle work.

Besides the street railway, the same company operate a 30 mile road that passes the Montmorency Falls and the Shrine of St. Anne De Beaupre, famous for the many miracles worked there. The cars on this road are 55 feet long and are equipped with four 50 h.p. Westinghouse motors geared for 50 miles an hour, and have Westinghouse air brakes.

At Montmorency there is, electrically operated, an elevator taking passengers up the side of the cliff, landing them close to the Kent House, at one time the residence of the King's grandfather, now a first-class hotel and pleasure resort, and run by the railway company.

Mr. A. Thomson is president, and Mr. E. A. Evans general manager and chief engineer of the Quebec Railway, Light and Power Company.

THE QUEBEC-JACQUES-CARTIER ELECTRIC COMPANY.

Perhaps one of the most interesting features in connection with this relatively young company is the great rapidity of growth of its connected capacity, and this in spite of the severe competition it has had to contend with. A few figures to prove the above statement may be of interest. Having first started to operate in March, 1900, the connected load had already reached 800 k. w. in October of the same year ; 1200 k. w. was reached in January, 1901 ; 1600 k. w. in July, and 2,050 k.w. in December of the same year ; at the time of writing over 2250 k. w. has been reached.

The Quebec-Jacques-Cartier Electric Company—View of Dam and Bulkhead, Showing Flashboards on Dam.

THE POWER HOUSE.

The power house is situated on the Jacques Cartier River about twenty miles from the central portion of Quebec city. Water at 33 feet head is led to it through two 14-feet penstocks about 200 feet long.

The inside of the power-house is divided into three main divisions, the dynamo room occupying half of the whole building ; the lower portion of the other half contains the dynamo and exciter wheels. Above this are the living quarters of the working staff and the step-up transformers. In the dynamo room there are two Westinghouse units running at 150 r. p. m., able to carry a maximum load of 1,500 h. p., direct connected to 54 inch McCormick water wheels, and two exciters, each having enough capacity to excite both generators. These two small units are also direct connected to 18-inch turbines.

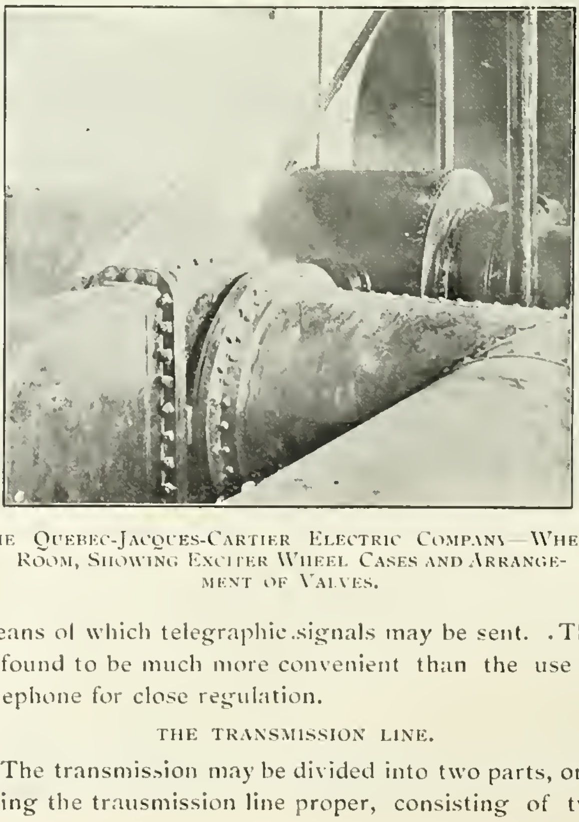
The switchboard consists of five panels, one exciter panel, two generator panels and two line panels, wired up in the standard Westinghouse fashion.

The Quebec-Jacques-Cartier Electric Company—Power House from Bulk Head.

Two Lombard governors were installed, but have not yet been put in operation, fearing hammer effect in the penstocks in case of a sudden shut-down. Standpipes are at present being erected at the power-house end to each penstock. The work on these is now nearly completed and as soon as finished the governors will be connected in.

There are two sets of oil cooled step-up transformers, raising the voltage from 2200 to 22000 volts ; each set is three-phase delta connected.

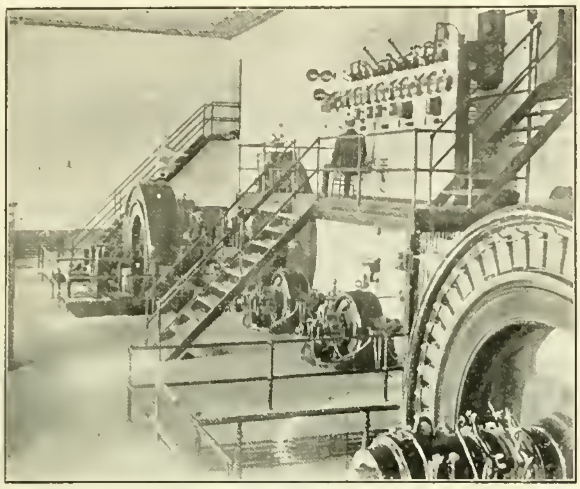
The system of signaling from distributing switchboard for obtaining proper regulation is most convenient and up-to-date. It consists of instruments ingeniously placed at each end of the telephone line, but without interfering with it in the least, and by means of which telegraphic signals may be sent. This is found to be much more convenient than the use of telephone for close regulation.



The Quebec-Jacques-Cartier Electric Company—Wheel-Room, Showing Exciter Wheel Cases and Arrangement of Valves.

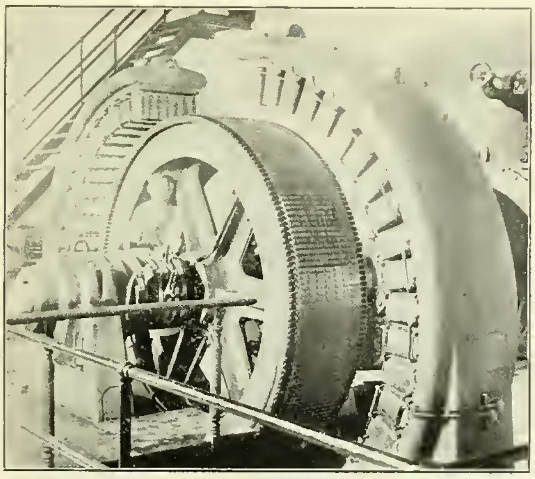
THE TRANSMISSION LINE.

The transmission may be divided into two parts, one, being the transmission line proper, consisting of two three-phase 22,000 volt lines, 18 miles in length and extending from the power-house to the step-down transformer house, which is located just outside the city limits. The wires on these lines are No. 4 hard drawn bare copper, strung 18 inches apart to form an equilateral triangle (with apex on top) on each side of the pole.



The Quebec-Jacques-Cartier Electric Company—View of Dynamo Room.

To overcome different obstacles and according to territory over which the line has to pass, various size poles had to be used ; these range from 35 to 75 feet. These two lines are protected at both ends with sets of Wurts lightning arresters arranged in the standard Westinghouse fashion. In the step-down transformer house, besides the lightning arresters just referred to, are two sets of Scott connected oil-cooled transformers, converting current at 22,000 volt three-phase to current at 2,200 volt two-phase.



The Quebec-Jacques-Cartier Electric Company—View Showing Generator.

The second part of the transmission, two miles in length, consists of two two-phase 2,200 volt lines of two No. 00 wire, strung on two separate pole lines, and extends from the step-dwon transformer house to the central portion of the city, where the distributing switchboard is located. These two pole lines, although starting and terminating at the same points, follow a perfectly different route through the city.

DISTRIBUTING SWITCHBOARD AND CITY DIRTRIBUTION.

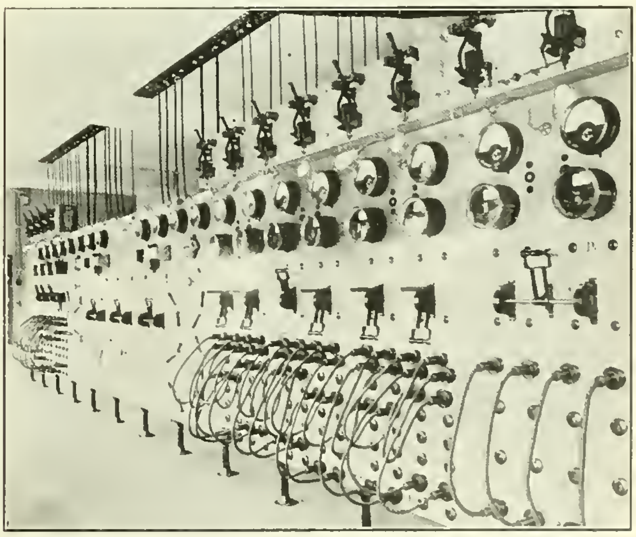
The distributing switchboard consist of twelve panels of blue Vermont marble mounted on iron frame about one foot from the floor. There are three in-coming line panels, two now in operation and one spare, two regulator panels and five feeder panels. Besides these there is a panel for the power circuit and one blank. In circuit with the in-coming lines are indicating watt-meters, ammeters and recording voltmeters. The feeder panels include ammeters, recording watt-meters and a system of plugging by means of which any circuit may be put onto either phase of any line. I.T.E. single pole circuit breakers are placed on each feeder circuit on separate mountings over each panel.

The Quebec-Jacques-Cartier Electric Company—Step Down Sub-Station.

On the two regulator panels are placed the regulators, one for each feeder. Then connected with two 350 range voltmeters, one mounted on each regulator panel, are the pressure cables which carry the pressures back to the switchboard from different points on the secondary systems.

The city is divided into several districts fed by separate single phase primary feeders (as may be noted from the description of the switchboard the power distribution is quite separate from the lighting).

In each of these districts is a main bank of transformers connected to feed a three-wire secondary system (108 volts on each side). On these banks the standard of transformer used is 15 k. w., although banks or distributions with smaller size transformers exist when convenient. In the secondary distribution the three wire system is very much adhered to, being even used for service wires strung on house brackets from which several customers are fed. The outlying



The Quebec-Jacques-Cartier Electric Company—Distributing Switchboard.

districts are fed from independent transformers, most of them on the two wire system.

The company has recently moved into its spacious new quarters, where the whole of the ground floor is devoted to general offices, the appointments of which are rich and imposing. The new distributing switchboard is on the floor above the office, and also on this floor is a complete laboratory for testing apparatus and for experimentation. The engineers' offices are partitioned off from the switchboard room by means of a glass partition, so that the engineer and his assistants have a full view of the operating room. Immediately above the switchboard floor is the distributing tower composed of slate slabs, and on both sides of same are store-rooms. In the basement are the stock and inspector's departments, and on account of the lay of the land the back entrance opens onto the street in the rear.

The Quebec-Jacques-Cartier Electric Company—General Offices and Distributing Station.

The Quebec-Jacques-Cartier Electric Company—Corner of Manager's Room.

FUTURE EXTENSION OF PLANT.

Having recently obtained the contract for the city lighting, the company has ordered and will shortly install all necessary apparatus. This will consist of two main units of 200 h. p., 2200 volt, G. E. induction motors. On each side of these will be direct connected one two circuit 6.6 ampere brush D. C. arc dynamo. It will also comprise a third unit of 100 h. p. with only one arc dynamo. The switchboard controlling this apparatus will be of eight panels, one for each of the motors and five for arc machines and circuits. The type of lamps to be used will be the latest G.E. direct current enclosed arcs.

Contracts have recently been awarded by the company for the erection of a steam auxiliary plant of 1800 h. p. capacity. This is to be situated outside the city limits in the neighborhood of the step-down transformer house. Three units of equal capacity will be installed, each consisting of a cross-compound condensing Robb Armstrong engine belted to a 2200 volt revolving field Bullock generator. The two 2200 volt transmission lines described above will be controlled at that end from the switchboard in the auxiliary plant. The arrangement on this switchboard will be such that by a system of plugs either line may be fed from either set of step-down transformers or from the auxiliary plant itself.

Mr. Edward Slade,
General Manager Quebec-Jacques-Cartier Electric Company.

Mr. Emerson McMillan, of New York, is president of the company, and Mr. Harold Kennedy, of Quebec, vice-president. The general manager is Mr. Edward Slade, and the chief electrician Mr. L. Denis.

Mr. L. Denis,
Chief Electrician Quebec-Jacques-Cartier Electric Company.

The employees of the Montreal Light, Heat and Power Company presented their late manager, Mr. W. H. Browne, with a beautiful silver loving cup as a slight token of their appreciation.

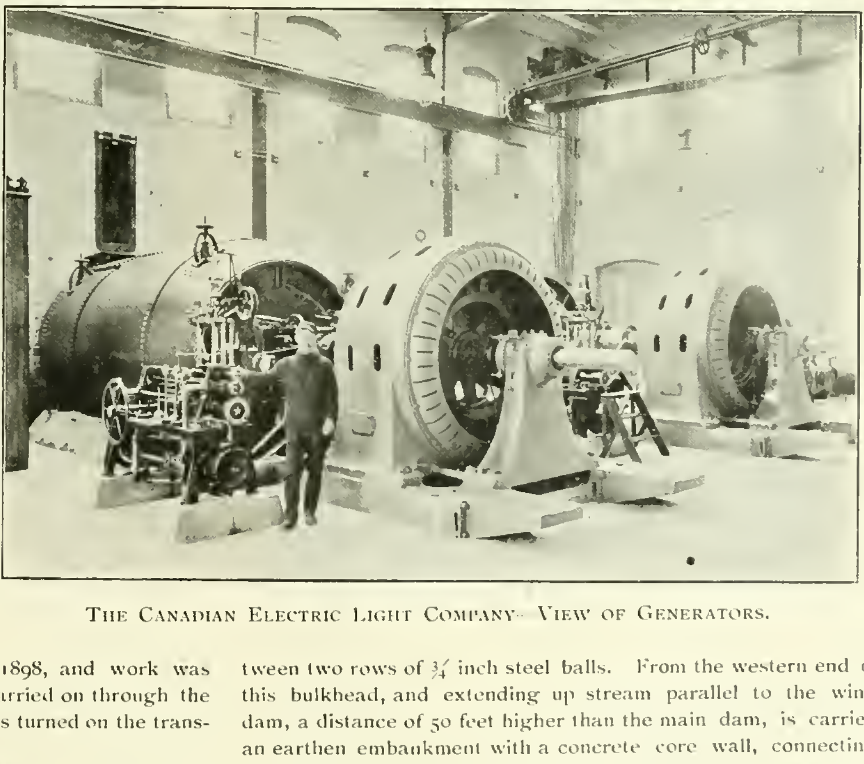
CANADIAN ELECTRIC LIGHT COMPANY'S WATER POWER DEVELOPMENT AT CHAUDIERE FALLS.

The River Chaudiere takes its rise in Lake Megantic, which is situated in the counties of Beauce and Compton, near the southern boundary of the Province of Quebec. Draining an area of some 2,400 square miles, it flows north, increasing in volume by the addition of several tributaries, until it reaches the falls of that name, situated about two and a half miles from where it discharges into the St. Lawrence. The catchment area being very rocky and sparsely wooded, the fluctuation in flow between high and low water is very perceptible. Previous to the development of this power, gaugings taken of the minimum annual flow indicated that 35,000 cu. ft. per minute might be depended upon. These measurements have since then been verified, showing the lowest flow to be during the summer months and early fall. The winter flow averages higher and is much steadier. This volume of water is precipitated over a cliff, forming what are known as Chaudiere Falls, a height of 85 feet, and then over rapids, a further drop of 11 feet, in a distance of about 1,000. When impounded above the falls by a dam 18 ft. high this would give a working head of 114 ft., and develop 6,000 h. p. at shafts of turbines of 80 per cent. efficiency.

The Canadian Electric Light Company—Power Dam.

Having the object in view of developing and transmitting electrically this power to the cities of Quebec and Levis, for use as heat, light and power, the Canadian Electric Light Company was formed with charter rights extending over the Province of Quebec.

The services of Messrs. T. Pringle & Son, hydraulic engineers, of Montreal, were engaged to draw up the plans and specifications, and supervise the work during construction. Preliminary surveys were made in the fall of 1898, and work was commenced in September, 1899, being carried on through the winter and following summer. Current was turned on the transmission line April 2nd, 1901.



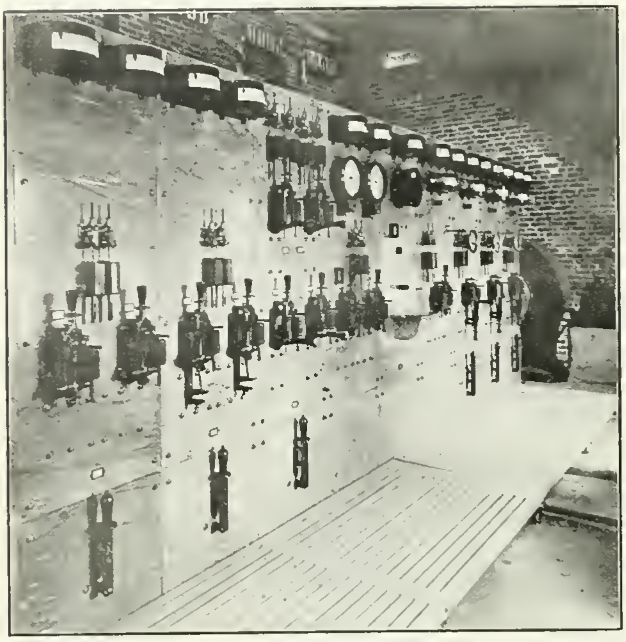
The Canadian Electric Light Company—View of Generators.

The development above the falls consists of a main dam of concrete masonry, extending across the river for 826 feet, being connected to the east shore by a heavy concrete abutment with walls 6 feet thick, carried well into the clay bank, filled in behind with earth and clay. The western end of the main dam terminates in two heavy sluiceway piers, the sluiceway itself being 12 feet wide. A wing dam joins these piers to the bulkhead, extending down stream a distance of 150 feet, forming the eastern boundary of a head race. This dam is of the same cross-section as the main dam, being 18 feet high and 20 feet broad at the base. The bulkhead, parallel to the main dam, and at right angles to the wing dam, is 28 feet high, 20 feet broad at the base, and 6 feet broad on top, being 10 feet higher than the main dam. It is constructed of concrete masonry, having built into it heavy I beam rack supports, stop log hoists, and three connections to penstocks 8 feet 3 inches in diameter. At the termination of these connections, and back of the headgates, four vertical air ducts lead to the top of the bulkhead, permitting of inlet and exit of air during filling or emptying of penstocks. The head gates in front of the penstock openings are of special design, being built of 8 inch I beams, spaced 12 inches apart, riveted to ⅜ inch plate, completely covering the whole area of the gate. The gates are constructed in two parts, the upper section, about 27 inches, being lifted first, leaving an opening 12 inches wide, permitting water to enter and fill the penstock, balancing the pressure on both sides, when the lower and larger section can be more easily raised.

The hoisting mechanism, operated by hand, consists of a double purchase winch geared to a vertical steel stem 4 inches in diameter, having a double screw of square thread mounted between two rows of ¾ inch steel balls. From the western end of this bulkhead, and extending up stream parallel to the wing dam, a distance of 50 feet higher than the main dam, is carried an earthen embankment with a concrete core wall, connecting the bulkhead to an abutment similar to that on the east shore. Another embankment at right angles to this abutment is carried in shore a distance of three hundred feet to high ground, having a concrete core wall connecting the abutment to the bank.

The reservoir impounded by these head works contains over 70,000,000 gallons of water, and extends up stream about one mile.

Trouble from frazil and anchor ice has not been experienced at this development, partly due to the location of three small islands at the west side of the pond and in front of the head race, deflecting the main current of the river towards the east shore, carrying the frazil over the eastern part of the main dam.



The Canadian Electric Light Company—Front View of Switchboard in Sub-Station.

Provision is also made for the deflection of anchor and frazil ice over the main dam by five crib piers placed in front of the head race, set in such positions as to deflect ice, and also provide protection to the racks from heavy ice during spring freshets. Between these piers booms are changed to deflect debris from head race, and behind this a second boom four feet deep prevents any debris or frazil ice from lodging on the racks.

PENSTOCKS.

Provision has been made at the bulkhead for three penstocks, 8 feet 3 inches in diameter. At present but one is installed, connecting No. 1 cone in the bulkhead with Nos. 1 and 2 units in the power house. The first 160 feet from the bulkhead is nearly horizontal, there being a slight drop. It then descends the hill at angle of about 40 degrees for a distance of 140 feet, and then horizontally for a distance of about 60 feet, where it enters the power house by two elbows. The bends over the brow of the hill and to the horizontal at the foot are of a radius of about 40 feet, reducing the friction to a minimum and allowing ample room for expansion and contraction, there being no expansion joints. The courses are five feet wide, the thickness for the first 160 feet being 5-16 plate, the remaining 200 feet are of ⅜ plate. Plates are lapped at 3½ inches, double riveted throughout, the 5/16 plate by ⅝ rivets spaced 3 and 1½ inches between rows of rivets, and ⅜ plates by ¾ inch rivets, 3½ on centres and 1¾ between rows.

Saddles are provided for supporting the penstock, spaced 15 feet horizontally, consisting of 6 x 4 angles with 5″ channels braced diagonally, the angle iron being bent to fit the circumference of the penstock. These saddles are supported on concrete piers, to which they are securely anchored, the piers being firmly imbedded in the rock. Besides these piers, the penstock is anchored on the brow of the hill, and in two places on the decline by 2″ anchor bolts connected to the penstock by heavy angles and steel pins, and to anchor tox bolts imbedded in 7 feet holes v [illegible] ement grouting. These tie rods are provided with turnbuckles for adjusting the strain, which is almost parallel to the centre line of the penstock.

The contract for 339 feet of this penstock was given to Messrs. Carrier, Laine & Company, of Levis, and the connection to the turbine cases and penstock to the Caledonia Iron Works, of Montreal.

POWER HOUSE.

This building measures 52x82 feet outside, the foundations being set in heavy rubble masonry, laid in cement mortar, with concrete foundations for machinery and cement floor. The walls are of brick, the roof consisting of two layers of 1½ inch pine, laid diagonally on 8x12 southern pine purlins supported on steel trusses spaced 16 on centres. These trusses are set on latticed girders, which also support the runway for a 15-ton travelling crane. The east side of the roof is provided with a large skylight. The whole building is well lighted by two rows of windows, and is fire-proof throughout, with the exception of the roofing.

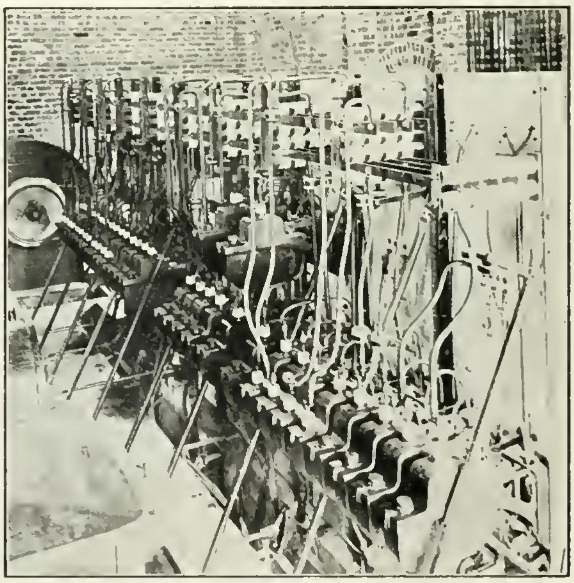
TURBINES.

The two units already installed consist of two McCormick turbines, built by the S. Morgan Smith Company, of York, Pa., having two 33 inch wheels, set with end inlet and central discharge, the buckets being of cast steel with heavy cast iron guide chutes. The dome lids are provided with adjustable water bearings and lignum vitæ steps. Each pair of wheels is mounted in a wheel case 9 feet in diameter, having a heavy cast iron head rivetted and braced to the case. The main body of the case is of 5-8 medium steel, having a tensile strength of 65,000 lbs.

Each pair of wheels is attached to steel shafts 21 feet long, 9 feet 6½ inches of which is 6 15-16 inches in diameter, the remainder being 5 15-16 inches, to which is keyed the runners which have a normal speed of 400 r. p. m. Rigid couplings are provided between turbine and generator, keyed to the shafts and forced on by hydraulic pressure. Cylinder gates controlling the water, which are operated by rods passing through the lid of the wheel case, are arranged with C. I. racks and steel pinions to receive the gate gearing of Lombard governors and provided with counter weights for balancing.

Draft tubes 29 feet long, 5 feet 6 inches in diameter at upper end and 6 feet 6 inches at lower end extending into the wheel pit, provide exit for the water. These wheels were rated at 1400 h. p., but have exceeded this guarantee under 112 feet working head, and have an efficiency of over 73 per cent. under full load.

The speed regulation is controlled by Lombard type "B" governors of the oil pressure class, having the pressure pumps on concrete floor stands on the opposite side of the shafts from the governors. As an auxiliary to these governors, and largely aiding them in close regulation under this head, two balanced relief valves are placed at the foot of the penstock, just before it s connected to the wheel cases. These valves have 15 inch pistons in a cylinder, one end of which is connected to the penstock directly. The opposite end is connected to a four inch pipe inside the penstock, extending up towards the bulkhead for 160 feet. When working normally, this "static head" pipe keeps the piston in equilibrium, the pressure on both sides being balanced. Any ram in the penstock due to a sudden closing of the gates, increasing the pressure on the end of the cylinder directly connected to the penstock, opens the valve, which remains open until the pressure has been equalized. The sensitiveness of this arrangement is controlled by check valves hav



The Canadian Electric Light Company—Rear View of Switchboard in Sub-Station.

ing spiral springs, the tension of which can be adjusted to open the relief valve under one lb. per square inch increase of pressure. These valves were built by the Lombard Governor Company, of Boston. This governor has operated very successfully since installation, having taken care of the machines when the full load has been suddenly taken off the generators. The generators have been operated in parallel with both governors on or with one governor on and one machine operated by hand, the governor adjusting gate opening to suit fluctuations in load.

THE CANADIAN ELECTRIC LIGHT COMPANY—LAYING THE CABLE.

GENERATORS.

Two generators are at present installed, of the three-phase revolving field type, built by the Canadian General Electric Company. These machines are rated at 750 k. w. on non-inductive load at a normal potential of 10,500 volts, with a frequency of 66⅔ cycles, and a speed of 400 revolutions per minute, capable of delivering 25 per cent. overload for four hours and 50 per cent. overload for one hour without excessive heating.

The construction is similar to the latest types of General Electric generators. The cast iron amature frame is of a strong box section, into which are dovetailed the iron punchings of the core, the windings being set in slots held in place by wedges driven over them. Ventilating spaces between the amature laminations provide for ample circulation of air.

The cast steel revolving field, weighing 13,000 lbs., has 20 projecting poles dovetailed into the steel spider. The sheet punchings forming the field poles are of high permeability. The field coils consist of copper strip wound on edge, and are insulated from the frame to withstand the regular American Institute test of two and one-half times normal voltage. The peripheral speed of the revolving element is well within safe limits, allowance having been made for an excess in speed of 30% without injurious results, the high speed permitting of a very compact design with good ventilation and lower cost per k.w. output. The total weight of each generator is about 35,000 pounds each.

The guaranteed efficiencies under different loads are as follows: Full non-inductive load, 94 per cent; ¾ load, 93 per cent; ½ load, 90 per cent; ¼ load, 83 per cent. By actual test both in the factory and at the power house these machines have shown a full load efficiency of slightly over 95 per cent. The regulation on non-inductive loads is 8 per cent. and with loads having power factors of 90 and 80 per cent. the regulation is 16 and 20 per cent. respectively. These machines show a rise of temperature of 38 per cent. after running 24 hours at full non-inductive load, and a rise of 45 per cent. at 25 per cent. overload.

The armature can be slid away from the field, exposing the coils and field windings for inspection or repairs. The sheet iron punchings forming the core are made of iron of high permeability, and no hysteresis, being japanned before assembling, and further insulated from each other by sheets of insulating paper reducing the eddy current loss. The armature coils are very carefully insulated before being put in the slots by specially prepared moisture-proof insulation not affected by moderate heat, each layer of insulation being carefully covered with insulation compound and well baked before another layer is wound on the coils. The windings are arranged so that any coil can be removed and another inserted to take its place. Insulation test of 23000 volts between coils and frame was maintained for 2½ minutes without any injurious effects.

Two exciter units of 30 k. w. are installed, each one capable of supylying full load excitation current for both main generators. These machines, of the General Electric, moderate speed, multipolar type, are direct connected to 50 h. p. McCormick turbines, having 12-inch bronze runners. Mechanical governors regulate the speed to suit all conditions of load.

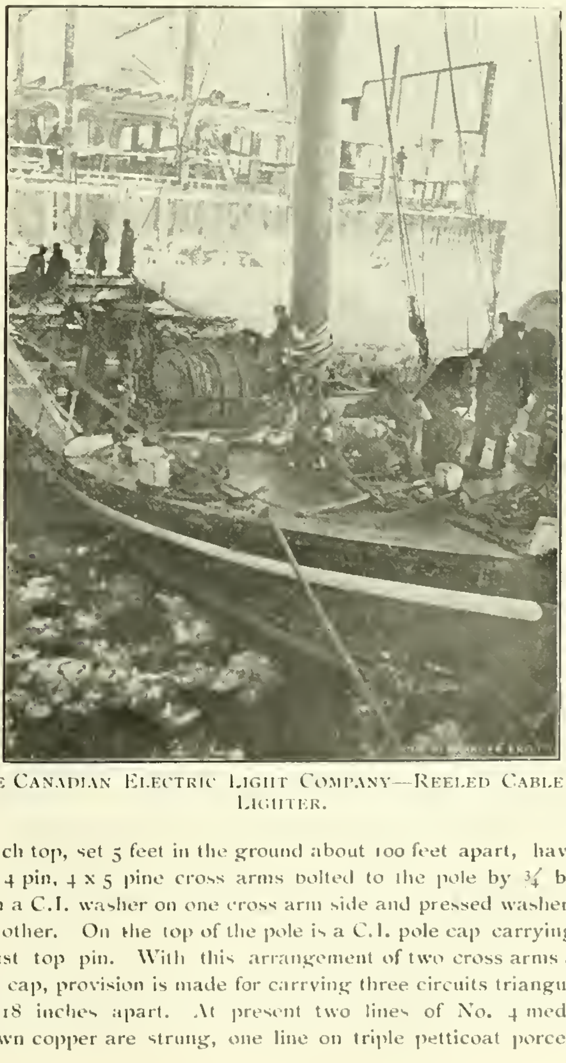
The switchboard contains four panels of blue Vermont marble, with all instruments of marine black finish. Each generator has a separate panel, the exciter instruments and synchronizing lamps on a third, with two line switches and three phase electrostatic ground detector on the fourth. Triple pole oil switches, of the General Electric Company's type "K," control the current from the generators to the 10,000 volt bus-bars, and from the bus-bars to the transmission lines. These switches are capable of breaking in oil 100 amperes at 15,000 volts.

Thomson inclined coil instruments are used on this board, one ammeter per phase on each generator panel, with a voltmeter and field current ammeter. The field current is controlled through rheostats, giving a range of 10% above normal and 20% below normal working voltage. From the generators to the switchboard a three conductor, lead covered cable, insulated to withstand 25,000 volts, is run in tile ducts carrying the high voltage current. Single conductor cable connects the line switches to the two transmission lines outside the building, passing through the brick wall in 4 inch tile elbows filled with insulating compound, and having bells connected to the lead casing, preventing any injurious effects from static discharges.

Protection from lightning is through Wirts lightning arresters of the G. E. pattern, connected to each phase just before it passes through the brick wall of the power house.

TRANSMISSION LINE.

The main transmission line, extending from Chaudiere Falls to Levis—a distance of nine miles—consists of 35 ft. cedar poles, 7 inch top, set 5 feet in the ground about 100 feet apart, having two 4 pin, 4 x 5 pine cross arms bolted to the pole by ¾ bolts with a C.I. washer on one cross arm side and pressed washer on the other. On the top of the pole is a C.I. pole cap carrying a locust top pin. With this arrangement of two cross arms and pole cap, provision is made for carrying three circuits triangulated 18 inches apart. At present two lines of No. 4 medium drawn copper are strung, one line on triple petticoat porcelain


THE CANADIAN ELECTRIC LIGHT COMPANY—REELED CABLE ON LIGHTER.

insulators of the Imperial type known as "Imperial No. 3", and the other on triple petticoat glass insulators. No. 6 tie wires are used, joints being of the well known Western Union type, well soldered.

Crossing the Chaudiere below the power house is made on No. 1 hard drawn copper, supported on either side by towers made of four poles forming the corners of a square, having 5 x 6 double cross arms with three insulators to each wire, the wire being tied around the arm on the center groove of the insulator. The poles are given a good rake in shore and heavily guyed with strain insulators and turnbuckles inserted. The wires are 30 inches apart, the span being 420 feet, each transmission line having a separate tower on either side.

Eight feet below the transmission lines are strung two galvanized iron No. 12 telephone wires on side blocks connecting the power house and sub-station. This line is also used for signalling between sub-station and power house for voltage regulation by cutting out the telephone and using current of low voltage with signal lamps on the switchboards.

Hon. L. P. Pelletier,
President Canadian Electric Light Company.

LEVIS SUB-STATION.

In this station, situated near the outskirts of the town of Levis, on the heights overlooking the St. Lawrence directly opposite the city of Quebec, is located the step-down transformers and distributing switchboard of the company. The building is of brick, 22x42, with concrete floor and transformer foundations, with a wooden roof covered with galvanized iron, and is equipped with a two-ton travelling crane.

The two transmission lines enter the south side of the building to oil switches supported on the wall, twelve feet from the ground, connecting each line to a set of 10,000 volt bus-bars ¾x3-16 bare copper, the bars in turn being connected to four banks of step-down transformers through similar oil switches. These switches are made by the General Electric Company, and known as their type "K". The control of these switches from the board is through a system of bell cranks and levers passing between the transformers and up to the switches. By this arrangement the attendant has full control of both transmission lines and each bank of transformers without leaving the front of the switchboard.

Three banks of step-down transformers, consisting of 6 200-k. w. air blast Wagner type, connected in pairs with three-phase primary and two-phase secondary, having regulating dials on the secondary, allow a range of voltage between 2080 and 2690. The dial switches are connected to the front of the board by chains and sprocket wheels, allowing of separate phase regulation, or of regulating both phases simultaneously. These transformers being of the shell type, each coil is wound and spaced so as to give large cooling surface, and interlaced so as to reduce magnetic leakage to a minimum, maintaining excellent regulation on load of any power factor.

An air duct extends along the front of these transformers below the floor, with inlets through 12 inch circular ducts at the side of the base, the circulation passing upward between the coils to the top of the case, and is then deflected down through passages in the magnetic circuits towards the outlets into a discharge duct at the back of the base beneath the floor line. The efficiency of these transformers is as follows: Full load, 97.7 per cent; ¾ load, 97.3 per cent; ¼ load, 95.5; the regulation on non-inductive load, 1.36 per cent, and on inductive loads with 80 per cent. power factor, 3.32 per cent, the rise in temperature being 45 per cent. centigrade.

There are also installed two 150 Westinghouse oil cooled step-down transformers, Scott connected, three-phase to two-phase, with the same ratio of transformation as the Wagner type but not equipped with regulating dials. These transformers may al be worked in parallel, giving a maximum output of 2000 k. w.

The switchboard consists of nine panels, one being for each bank of transformers, equipped with ammeters for each phase, voltmeter, and four pole double throw circuit breaking oil switches made by the General Incandescent Arc Lighting Company, of New York. These transformers feed into two sets o bus-bars known as Quebec and Levis, from which circuits are led off to a distributing system in the towns of Levis, St. Joseph and St. Romuald, and two circuits to the submarine cable of the company, through which they are now supplying the Q. R. L. & P. Co. with 1,000 electrical horse power for use on their incandescent distributing system and motor circuits.

Two panels control the Levis distribution, equipped with ammeters on each phase, and single throw circuit breaking oil switches. A panel is also provided for separate control of the incandescent street lighting circuits. These circuits are operated in multiple, having separate transformers, one leg of the primary being connected to the circuit breaking oil switch, the other leg being in common between the street lighting transformers and the house transformers.

The Quebec bus-bars are connected to the trunk line through a separate panel, having one ammeter per phase, and recording voltmeters of the Bristol type, which are connected by pressure wires brought across the river through the submarine cable from the bus-bars on the distributing switchboard of the Quebec Railway, Light & Power Company. This permits of regulating the voltage on the Quebec shore through the medium of the regulating dials on the transformers. A panel is provided with electrostatic ground detector and voltmeter plug set, whereby the voltage on the bus-bars may be determined and circuits tested for grounds. The board is 18 feet long, 7 feet high, of blue Vermont marble, all instruments and switches having a black marine finish. Voltmeters and ammeters are of the Wagner horizontal edgewise type. It was designed after plans made by the general manager, and built by the Wagner Electric Manufacturing Company, of St. Louis, and installed by Mr. A. C. Read, construction superintendent of the company, who installed the complete equipment of the sub-station.

Mr. G. U. G. Holman,
General Manager Canadian Electric Light Company.

Protection against lightning is provided by Wirts lightning arresters, a set being installed on both transmission lines where they enter the sub-station.

The blower set for providing air for the air blast transformers consists of a 30 inch Sturtevant fan, belted to duplicate 3 h. p. Wagner single phase motors.

SUBMARINE CABLE.

This company are now transmitting between Quebec and Levis 750 k. w. through a submarine cable laid across the St. Lawrence opposite the city of Quebec, at a potential of of 2,500 volts. This cable was laid in order to fulfill a contract between the company and the Quebec Railway, Light & Power Company, whereby the former was to deliver to the latter 1000 electrical horse power continuously for five years. In order to accomplish this, two methods suggested themselves—one of areial suspension similar to that now employed by the Bay Counties Company, of San Francisco, across the straits; and the other of a submarine cable. The former method was the more expensive and hazardous, the distance between shores being about 4,800 feet. The latter method was therefore adopted, and has been in continuous operation since the 11th of February last, successfully transmitting current for both light and power between the two shores.

The length of the cable, laid down, is 4,350 feet, and it is composed of four No. 2-0 B. & S. gauge standard conductors and four No. 14 pressure wires, made up as follows: Each stranded conductor (composed of 19 strands of soft copper wire thoroughly tinned) is insulated with a wall of best para rubber compound of a minimum thickness of one-eighth of an inch, wrapped with heavy rubber filled tape. The four conductors are twisted together around a jute centre, and have on the periphery between each other the four rubber covered pressure wires, the whole covered with heavy rubber filled tape and served with two layers of tarred jute.

Mr. P. G. Gossler,
President Canadian Electrical Association.

The armor consists of 30 No. 6 B.W.G. galvanized steel wires, the outside diameter of the cable measuring 2 5/16 inches, and the weight being 6½ lbs. per foot. Before laying a pressure of 12,500 volts was applied between conductors for five minutes, and the following insulation and capacity measurements made:—

Before armoring: Actual insulating resistance per conductor, 1,003 meghoms; per mile, 835 meghoms; actual capacity per conductor, 785 microfarads, per mile .943 microfarads. After armoring: Actual insulation resistance, per conductor, 952 meghoms; per mile, 794 meghoms; actual capacity, per conductor, 863 microfarads; per mile, 1.036 microfarads. The measurements given are the average taken on the four conductors.

The cable was coiled on a flat car at the factory of the cable company, New York City, and on reaching Levis was transferred to a reel erected on board a lighter moored at the wharf. The drum of the reel was 8 feet in diameter, and equipped with winches and breaking attachments. The season of the year at which the cable was laid made the undertaking particularly hazardous. The thickness of the ice was increasing daily, making it necessary to obtain the services of the Quebec & Levis Ferry Company's ice breaking steamer "Queen" to clear a passage in front of the tug towing the lighter,

On the morning of December 11th, after waiting for two days for the river to present a favourable appearance for crossing, and with the tide just on the ebb, the procession started from the Levis shore, and in twenty minutes the lighter was moored on the Quebec side of the river. The ice in the river was from 8 inches to 2 feet in thickness, but the ice breaking steamer cleared a passage with ease, the cable being paid out from the stern of the lighter steadily and evenly as the crossing was made. The cable terminates on each shore on a terminal pole on which are mounted boxes containing lightning arresters, and cable bells four inches in diameter, filled with micanite compound, through which the conductors are brought, and connected to the respective trunk lines of the two companies. The pressure wires are connected to the bus-bars of the Quebec Railway, Light & Power Company's switchboard at their sub-station, and on the Levis side to recording voltmeters, the attendant in the Levis sub-station regulating the potential to suit the requirements of the Quebec sub-station.

On the Levis shore the cable terminal is connected to the sub-station of the Canadian Electric Light Company by four 2-0 conductors, a distance of about half a mile.

This cable was supplied by the Safety Insulated Wire & Cable Company, of New York, and delivered fifteen days from date of order. Mr. Rodier, construction superintendent of that company, had charge of the laying and connecting, and deserves great credit for the able manner in which he performed his arduous duties.

The Board of Directors of the Canadian Electric Light Company consists of Hon. L. P. Pelletier, president; H. T. Machin and Gaspard LeMoine, vice-presidents; H. M. Price, R. Audette, Charles King, Wm. Marsh, H.S. Holt and H.E. Smith. Mr. Pelletier has been connected with the company since its organization, having served on the board of directors, and for the past two years as president.

The officers of the company are G.U.G. Holman, general manager; A. R. Henry, general superintendent; A. C. Read, construction superintendent; A. Blanchet, power house superintendent; E. LeSauteur, treasurer; George Belleau, secretary. Mr. Holman was born at Talca, Chili, July 13, 1866. He was graduated from the Institute of Technology in 1889, and entered the employ of the Thomson-Houston Electric Company at Lynn, Mass. He remained with this company after its consolidation with the Edison Electric Company, serving in St. Paul, Minn., for the last years of his time. In 1892 he left the General Electric Company and took the position of railway engineer of the Mather Electric Company, of Manchester, Conn. After the panic of 1893, in which this firm failed, he went to Philadelphia, Pa., as manager of the Cheltenham Light, Heat and Power Company, where he remained for nearly six years. In June, 1899, he left Philadelphia to accept a railway position in New York, and helped to put through the Seaboard Air-line consolidation. In May, 1901, he came to Quebec, Canada, to become general manager of the Canadian Electric Light Company. Mr. Holman is a member of the Franklin Institute of Philadelphia, an associate member of the American Institute of Electrical Engineers, and a member of the Technology Club, Boston. During the past year he has been elected to the executive committee of the Canadian Electrical Association.

HAND-FIRING VERSUS STOKERS.

Comparative tests were recently completed at the plant of the T. Eaton Company, Toronto, between hand-firing with McClave shaking grates and the Jones underfeed stokers. The boiler plant at the T. Eaton Company consists of five 150 h. p. and two 400 h.p. Heine boilers. The main object of making this test was to determine with accuracy the cost to make the steam under ordinary working conditions. During the day the boilers were run to the full capacity, while during the night the load was below the rating of the boilers. The particulars of the tests are given below:

PARTICULARS.	HAND FIRED	JONES STOKER.
Date of Test.......................April, 1902	21-23	23-25
Duration of Test, continuous, including night run, in hours	48	48
West Virginia Slack Coal.............		
Total Coal burned............... .....in lbs.	93,500	80,500
Total water pumped into boiler and evaporated into steam........................ .... in lbs.	570,580	611,879
Total equivalent from and at 212 ....in lbs.	605,134	646,439
Total Ash...............................in lbs.	12,295	7,941
Percentage Ash	13.1	9.87
Average Steam Pressure........lbs. per sq. in.	110.3	116.3
Average Feed Temperature.........deg. Fah.	194.4	198.6
Average H. P. developed during entire run at 34½ lbs...........................	366.	390.3
Heat given 1 lb. water at temp. of feed to convert same into steam at boiler pressure....B.T.U.	1024.5	1020.4
Actual evaporation per lb. coal..........in lbs.	6.102	7.60
Actual evaporation per lb. combustible...in lbs.	7.026	8.55
Equivalent evaporation per lb. coal from and at 212°.............................in lbs.	6.461	8.03
Equivalent evaporation per lb. combustible from and at 212°.........................in lbs.	7.452	8.9
Cost to evaporate 1000 lbs. water, coal at $3.25 per ton....................................	$0.251	$0.2023
Relative economics................................	100	124.3
Increased evaporation for equal fuel		24.3

C. E. A. CONVENTION PROGRAMME.

Wednesday, June 11th.

9.00 a.m.—Meeting of Executive Committee.

10.00 a.m.—Opening of Convention in Assembly Hall, Chateau Frontenac. Address of welcome by the Mayor of Quebec, the Hon. S. N. Parent. President's Address. Reading of Minutes. Reports and General Business.

2.15 p.m.—Special cars leave the Chateau Frontenac to visit the sub-stations of the Quebec Jacques-Cartier Electric Company and the Quebec Railway, Light and Power Company, arriving at car sheds of Q. R. L. & P. Co. at 3 p. m., where a paper will be presented by Mr. A. B. Lambe, jr., Toronto, Ont., on "The Electrical Equipment of an Ordinary Street Car."

8:00 p.m.—In Assembly Hall. Paper: "Development of Arc Lighting Apparatus from 1810 to 1902, with Special Reference to Modern Arc Light Engineering" (Illustrated), by Mr. W. D'A. Ryan, Lynn, Mass.

Thursday, June 12th.

10:00 a.m.—Papers: "Arc Lighting," by Mr. C. M. Green, Lynn, Mass.; "Lightning Protection and the Static Interrupter," by Mr. Percy H. Thomas, Pittsburg, Pa.

2:00 p. m.—Special cars leave Chateau Frontenac for the Shrine of St. Anne de Beaupre, Montmorency Falls and Kent House; members will also visit the Power House of the Quebec Ry., L. & P. Company at Montmorency.

8:00 p.m.—By kind permission of Lt. Col. Wilson, R. C. A., the Royal Canadian Artillery Band will give a concert on the Terrace.

9.00 p.m.—Annual Banquet, at Chateau Frontenac.

Friday, June 13th.

10.00 a.m.—Papers: "The Use of Storage Batteries in Electric Distribution Systems," by Mr. A. A. Dion, Ottawa; "Electric Suburban Railways," by Mr. Ed. A. Evans, Quebec, Que.

Selection of City for next Convention.

Election of Officers.

1.00 p.m.—At the invitation of Mr. Frederic Nicholls, 2nd Vice-President and General Manager of the Canadian General Electric Company, the members of the Association will be tendered a trip by steamer round Island of Orleans, visiting the docks, harbor and site of the new Quebec Bridge; returning to Quebec in time to connect with evening trains and Montreal steamer. Luncheon will be served on board.

Note: The general business of the Association will be transacted in the Assembly Hall, Chateau Frontenac. After page 75 of this issue was printed, the place of meeting was changed from the City Hall to the Chateau Frontenac.

DINNER TO MR. W. H. BROWNE.

The Montreal friends of Mr. W. H. Browne, late manager of the Royal Electric Company, tendered him a complimentary dinner on May 17th, prior to his departure for Great Barrington, Mass., to assume the management of the Stanley Instrument Company. The dinner was gotten up by the Knight of Columbus as a token of their appreciation of the services rendered to that society by Mr. Browne. It was likewise taken advantage of by the business men of Montreal to do honor to an esteemed fellow-citizen.

Over one hundred and fifty persons sat down to the dinner, which was held at the Windsor Hotel. The menu card was most artistic and an index to the character of the occasion. The finest orchestra in the city was in attendance, together with some of the best talent. The large dining hall was very tastefully decorated with English and American flags.

The toast list included "The King", "The President of the United States", "Our Guest", "The Dominion of Canada", and "The City of Montreal". The health of Mr. Browne was proposed by Senator Beique, who was at one time the vice-president of the Royal Electric Company. The Senator praised very highly Mr. Browne's talent. He had worked shoulder to shoulder with him in many important enterprises and could appreciate his excellent qualities. He had never met a man better organized bodily and morally for the work entrusted to him. His Worship Mayor Cochrane also spoke most highly of Mr. Browne and regretted exceedingly that Montreal was to lose a man of his character and business record. He believed that the Montreal, Light, Heat and Power Company was making a great mistake in allowing him to leave the city, as men of his ability were hard to find. The speeches of the evening showed the warm appreciation of all present for the guest of the evening, and were a fitting close to Mr. Browne's career in Montreal after the great work he had done in building up the company with which he was connected from a small beginning into a great and flourishing institution.

On rising to reply Mr. Browne met with a most enthusiastic welcome. He said he had done nothing in Montreal to justify so cordial a demonstration. Perhaps the principle he had established more than anything else was that Canadians were just as capable as were Americans. That was the principle they were really celebrating. It also showed the possibility of pursuing an honest, conscientious line of conduct in business life and being honored for it.

Hon. S. N. Parent, Mayor of Quebec.

The Western Electric Company, of Chicago, are reported to have secured the contract for arc lamps, etc., for the lighting of Montreal by the series alternating system.

An electric motor car carrying three passengers recently made the run of 486 miles—London to Glasgow—at a cost of £3 15s 3d for current and night attendance, or less than ½d per mile. Altogether, with the Glasgow trials and the return journey, the distance covered on the tour was 1,161 miles, which is probably a record for an electric carriage.

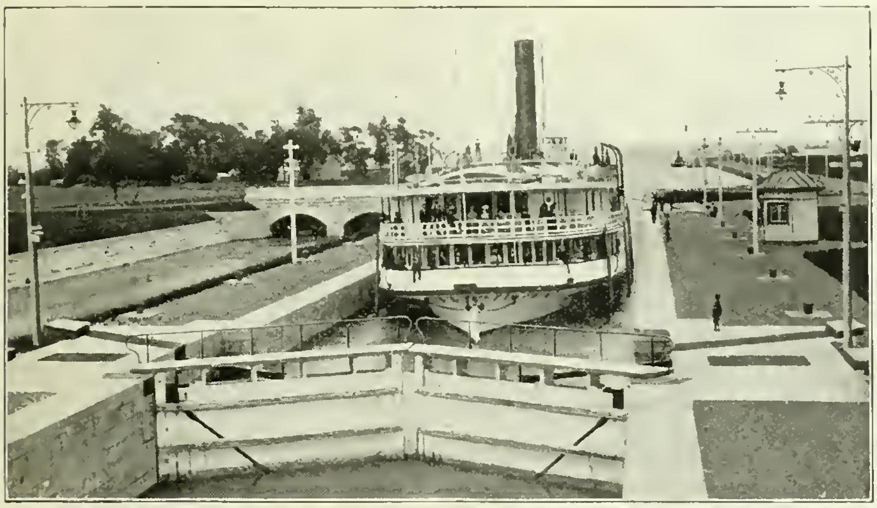
After having made trial of their capabilities, the Australian Commonwealth Government is reported to have determined to utilize motor cars for the collection of letters in all large centres. It is intended, further, to use the automobile for the conveyance of mails between the cities and the suburbs, and to introduce it for long distance carrying to outlying districts that are not served by the railways.

ELECTRICAL INSTALLATION FOR THE SOULANGES CANAL.

The Soulanges Canal, about 14 miles in length, couples Lake St. Louis to Lake St. Francis, the level of latter being about 82 feet higher than that of the former. Between the two levels only five locks are interposed, the first three having the exceptionally high lift of about 23 feet, the fourth a lift of about 12 feet, and the last a lift of about 2 feet.

The location and design of canal and locks, and supintendence of contruction, have been entirely the work of Mr. Thomas Munro, past president of the Canadian Society of Civil Engineers. His large and varied experience in canal work has led to the use of some novel features in the construction of this canal, and we understand that those best qualified to judge have pronounced it to be the finest canal on the continent.

Owing to the fact of a good water power being available on the canal, it was decided to install an electric plant for the operation of the locks, sluices and bridges, and to light the canal throughout its entire length. On account of the length of the canal the alternating current three-phase system was adopted.



Lock No. 5, Showing Steamer Leaving for Lake St. Francis.

The carrying out of this portion of the work was placed in the hands of the Canadian General Electric Company. The application of alternating current apparatus to work of this class being a novelty, many interesting engineering problems were encountered and successfully solved.

THE POWER HOUSE.

The power house is situated on the south bank of the canal at its point of crossing the Grease river, which is five miles from the upper entrance and nine miles from the lower entrance of canal.

The illustration gives a good idea of the general appearance of power house, designed by Cox & Amos, architects, Montreal. It is substantially and handsomely built of "Milton" pressed red brick, trimmed with buff Ohio sandstone sills and transoms. The building is two stories high, surmounted by an ornamental terra-cotta roof finished with copper sheathed turrets and trimmings. The generator room occupies the central portion of the building and extends the full width and height. One wing is used as a storehouse, and the other as a dwelling for power house attendants.

Office of Mr. Munro, Chief Engineer Soulanges Canal.

The hydraulic equipment was designed by Mr. A. M. Rice, of Dayton, Ohio. There are two wheel-pits, in each of which are installed two pairs of Victor turbines on one horizontal shaft operating under a twenty foot head at 225 r. p. m. and discharging into the Grease river, which acts as a tail race. Each set of wheels is furnished with a Geisler governor.

To each of the above water wheel units is coupled a three-phase revolving field, 60 cycle generator of 264 kilowatts capacity at 2400 volts, furnished by the Canadian General Electric Company, each being set on concrete foundation capped by heavy dressed stone. Two four-pole exciters are furnished, each of 17 kilowatt capacity at 125 volts, being sufficient to excite the fields of both generators. These are driven by belts from the main water wheel shafts.

The switchboard is of blue Vermont marble, the end being guarded by heavy brass grille work, which also extends around the top. It comprises five panels, 90 inches high, and has a total width of 12 feet. Two generator panels, each furnished with a three-pole main switch of the old break type, three ampere meters, one voltmeter, all of the Thomson inclined coil type, three expulsion fuse blocks, one voltmeter and synchronizing plug

Soulanges Canal Power House at Grease River.

switches, two pilot lamps, field rheostat and switch; one exciter panel furnished with two main exciter switches, two ampere meters, one voltmeter switch, two field rheostats and two pilot lamps; two feeder panels, each furnished with two three-pole quick break switches, one for power and one for arc lights, two ammeters, six expulsion fuse blocks, and one electrostatic ground detector.

The wiring is such as to admit of any circuit being connected to either or both machines. The cables between switchboards and machines are carried in conduit, which is covered by iron checker plate.

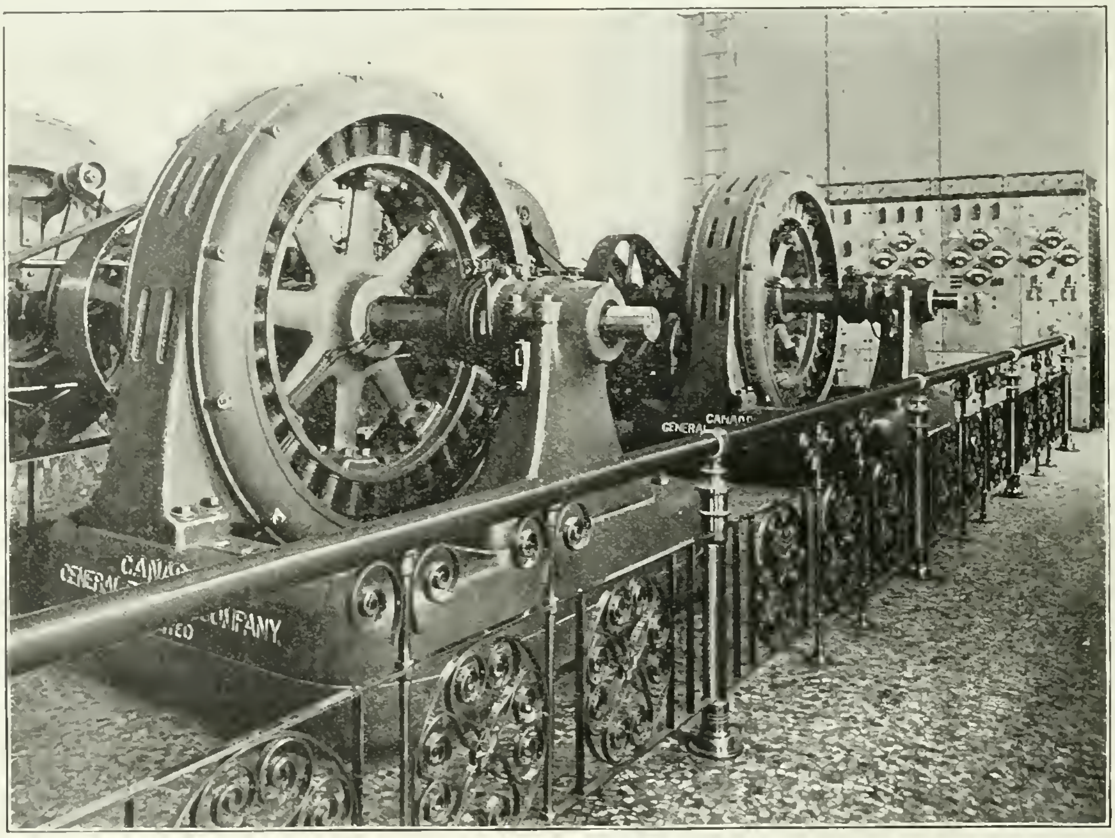
The lighting of the power house is carried out by means of 16 c.p. incandescent lamps, set very closely together just below steel beams which carry the travelling crane, each lamp being set at an angle of 45° with horizontal, and provided with a neat reflector. The wiring is concealed in moulding, and switches are provided to turn on the lights in sections. A hand operated travelling crane is provided of sufficient capacity to easily handle the heaviest part of generators. A novel feature of the generator room is the marble mosaic floor, which is worked into a neat and artistic pattern, also the substantial ornamental brass railing forming a passage-way down one side of the room.

The switchboard is connected to the transmission lines by means of highly insulated lead encased cables, which pass under the canal and terminate at fuse blocks placed in a neat terminal house, in which are also located the lightning arresters protecting said cables from lightning discharges.

THE TRANSMISSION LINES.

From this terminal house four three-phase circuits emerge. The circuit to upper entrance at Coteau Landing consists of No. 6 B & S., the arc lighting circuit being of the same size. The power circuit to the lower entrance at Cascades Point consists of No. 4 B & S., and the arc lighting circuit No. 2 B & S., all bare copper wires. These transmission lines are carried on red cedar poles, perfectly straight and dressed octagonal; they were brought from British Columbia, it having been found to be impossible to obtain satisfactory timber nearer. All poles are set six feet in the ground and one hundred and twenty feet apart, every fourth pole supporting an enclosed arc lamp. The lamp poles are 35 feet high, and the others 30 feet, and all are painted with four coats of white lead. The pole line represents an unusually neat and trim appearance owing to the fact that the poles were set and plumbed by the use of the Theodolite. All four-pin cross-arms are supported by an ornamental iron brace, the design of which is shown in accompanying cut. The brackets used for supporting the arc lamps are of similar ornamental design.

It having been found necessary in a section of the canal to decrease the slope of the bank, it was deemed advisable to keep the lamp poles at a uniform distance from the centre of the canal. Two piles were therefore driven into the canal, between which the lamp poles were set and bolted, shore guys being provided to guard against mishap. From the bank to each of these poles a painted wooden platform has been erected for the use of the lamp trimmer.



Interior of Power House.

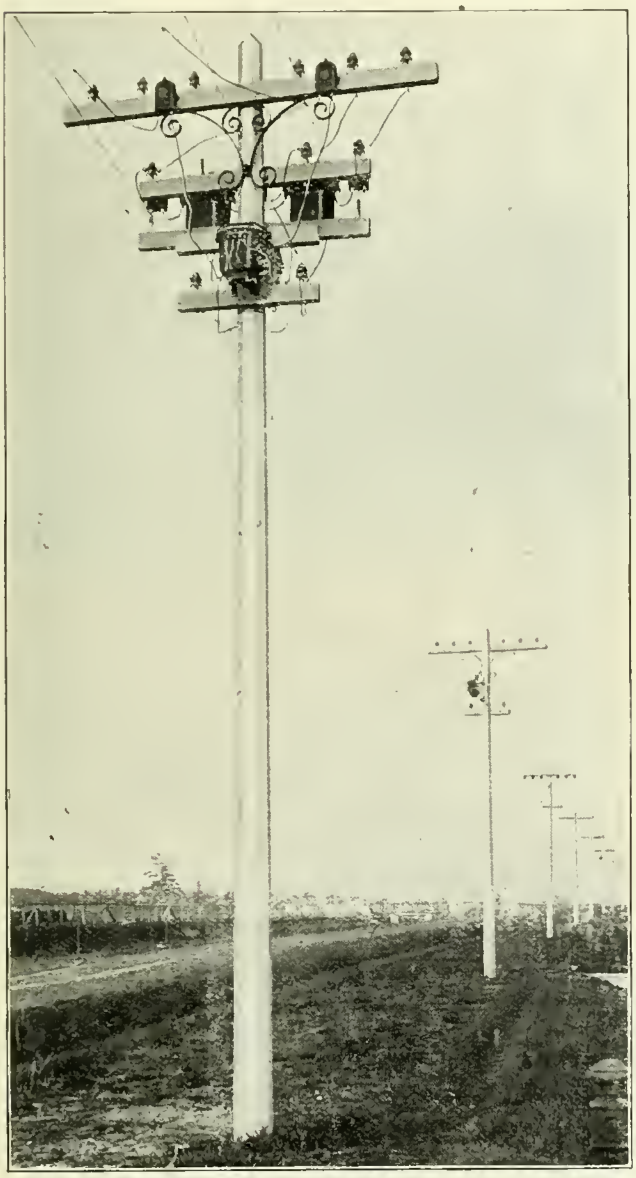
The arc lamps are of the Canadian General Electric Company's multiple enclosed arc type; the capacity is 7½ amperes, all being furnished with clear inner and outer globes. The lamp cases are weatherproof and are furnished with an enamelled metal reflector. These lamps being of the multiple type, are each provided with a thousand watt type "H" oil-cooled transformer. This extra capacity is provided to insure a large factor of safety, which precaution is adopted throughout the entire installation.

THE BRIDGES.

Crossing the canal at intervals are five electrically operated bridges. The motors and controlling apparatus are contained in a neat cabin situated on the side of each bridge. The motors are of two horse power capacity, operating at 220 volts, and are geared to the mechanism for turning the bridge. Between the electrical mechanism and the bridge gearing a flexible friction is interposed, which is operated by a lever and acts either as a clutch or a brake as occasion requires. The bridges each weigh upwards of 100 tons, and the mechanism is designed to open or close them within ten minutes. On top of each bridge a red lantern is placed exactly on the centre line of the canal, showing both ways, as a danger signal when the bridge is closed. This lantern is lighted by a cluster of incandescent lamps. Power is conveyed to the bridge by means of submarine cables from transformers placed on one of the line poles adjacent to the bridge.

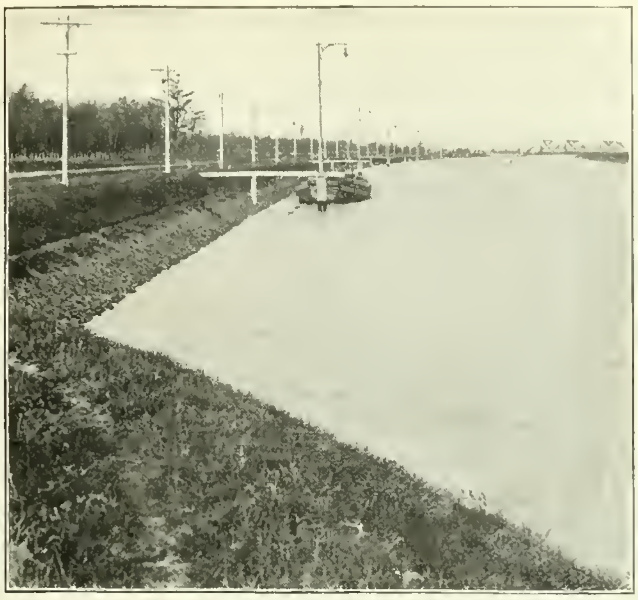
OPERATION OF THE LOCKS.

The locks are 200 feet long by 46 feet wide and are of massive concrete and stone construction. The lock gates are of particularly substantial construction and are built up of Douglas fir, which was obtained in British Columbia. The largest gates are over 40 feet high and 28 feet broad and weigh upwards of 70 tons. These gates are closed or opened by a steel I beam which has a rack secured to it, the rack being operated by a pinion. There is a recess in the back wall which receives the above mentioned I beam when gate is open.



View of Transmission Line—Pole with Bridge Motor Transformers in Foreground.

The lock gates and sluice valves are operated by Canadian General Electric Company's three-phase, 220 volt constant speed induction motors, in the following manner: The lock gate motors are of three h.p. capacity and are connected to the pinion which operates the rack by a pair of gears. At one point, however, is interposed a friction device which is so arranged that by operating a lever two friction pulleys can be brought into contact, thus applying the power to move the gate, and by reversing said lever a powerful brake is applied, which is used to arrest the motion of gate and thus prevent it striking with more than necessary force the mitre sill when closing or the recess when opening. This brake has another use, viz., that when the gates are open and a vessel is passing through the same tendency is for the gates to start to close, caused by the vessel's motion; the brake being applied effectually prevents this.



Special Construction of Lamp Poles.

That part of the above mechanism which is more intimately connected with the motor is housed in a cast iron box fitted with a rain-proof cover. The top of the box projects about 15 inches above top of coping of lock. The lever which operates the frictions is attached to a shaft which projects through the wall of box, as also does another shorter lever which operates a reversing switch used to reverse the direction of rotation of motor. The mechanism is so arranged that the power required to start motor is very small, the only friction at starting being that of a small pinion and gear and four bearings. The motor can thus be reversed in a very few seconds. This feature is of importance, as it enables the motion of the gate to be reversed with surprisingly small loss of time in case of emergency. In order that an operator can tell exactly when a gate is closed or open without specially looking

General View of Lock, Showing Location of Motor Boxes, Lamp Poles and Switch Cabin.

at it, an indicating device is arranged inside the box and an index band passing over a scale on the outside of box shows exactly when the gate arrives at the end of its travel in either direction. The above mechanism is so arranged that the gate will open or close in one minute.

The mechanism which operates the sluice valves is of exactly the same design as that which operates the lock gates except that the motor is of one horse power capacity. The mechanism is arranged to open the sluice valves in 45 seconds.

THE SWITCH HOUSE.

The transformers which supply current to the lock motors are contained in a switch house of artistic design, as will be seen by referring to the illustration. These transformers, of which there are two, are of 7,500 watts capacity, thus allowing ample margin for large overloads on the motors. The switch house also contains a fuse cabinet which holds a fuse block for each motor and each lighting circuit. Above the fuse cabinet is arranged an enclosed switch with a projecting handle to operate same. By means of this switch current can be cut off from the entire lock. As this switch house is used by the lock operators, everything is arranged with a view to the greatest possible safety, and therefore all metal carrying current is enclosed in a substantial and effective manner. These switch cabins are lighted inside by 16 c.p. incandescent lights. Outside these houses on the side facing lock are arranged six 32 c. p. incandescent lamps in marine weatherproof fixtures. The lock motors are connected to the fuse blocks in the above mentioned fuse cabinet by means of highly insulated lead encased cables, which enter the cast iron motor boxes through brass stuffing boxes.

One of the Highway Bridges, Showing Operating Cabin and Signal Lamp.

The general lighting of the canal by arc lights is very effective, making it practically as easily navigable by night as by day. Both entrances and all locks are lighted on both sides of canal.

OTHER FEATURES.

The electrical apparatus installed along the canal is very effectively protected against lightning, lightning arresters of the Canadian General Electric Company's short gap type being installed at each lock and at every point where cables pass under the canal for lighting, power or telephone services.

In order to facilitate the operation of canal, communication between all locks, bridges, offices and power house is carried on by a telephone system, which proves to be very efficient and effective.

To provide against the cold weather which usually occurs during the first three or four weeks after navigation opens and during the last few weeks at the close of navigation, electric heaters are placed in all lock switch houses and bridge cabins. These are 750 watts capacity each. This heating system is also extended to the power house, in which a 750 watt electric heater is installed in each of the living rooms and 4,000 watt heaters in the store room. The heaters are of the Simplex Electrical Company's manufacture.

Since the operation of the sluices, locks and bridges by electricity it has been found to result in a saving of labor equal to 50 per cent., there now being required for the operation of the locks only two men, instead of four as previously.

Night View of Canal from Railway Bridge.

Parliament Buildings and Grand Allee, Quebec.

Martello Tower, Quebec.

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

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The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in the delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

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The C. E. A. Convention.

THE subjects of the papers to be presented at this Convention are of great interest and value to all companies controlling or operating electrical industries. The two papers on arc lighting will be particularly valuable at this time when there is such an agitation through this country and the United States towards changing the present systems of street illumination for others of more economical operation. The subject to be presented by Mr. Percy H. Thomas of the Westinghouse Electric & Manufacturing Co., will also be particularly valuable at this time, inasmuch as there is a great diversity of opinion as to the proper means of protecting long distance transmission lines from static discharges and efficient protection from lightning, This paper of Mr. Thomas' in itself will be well worth going a long distance to hear. It is desirable that as much information as possible be brought out at this convention in regard to the systems in use throughout this country and elsewhere for protecting long distance transmission lines as well as local distribution systems from lightning. There will be two papers on street railway subjects as well as several topics for discussion by street railway men. The papers are all of a high standard and the discussion upon them will be participated in by men of high standing in practical and theoretical work. The papers and discussions alone will amply repay attendance at the convention, and it is expected that all departments of the electrical industry will be well represented.

Steam Turbines.

The apparent success which has accompanied the introduction of the steam turbine is attracting much attention, and by many it is regarded as one of the most significant steps that has been made in the engineering field in recent years. It is claimed that it represents the coming type of apparatus for this purpose. The largest steam turbine generator yet installed on this continent is in the power station of the Hartford Electric Light Company, of Hartford, Conn. It is a reserve unit consisting of a steam turbine of about 2,100 kilowatts capacity direct-coupled to a two-phase 2,400 volt generator, this unit being intended as an auxiliary to aid the water-power plant. Steam is generated in water-tube boilers, which are fired by mechanical stokers, bituminous slack coal being used. The steam turbine is of the Westinghouse-Parsons type. Steam is admitted at the govenor valve and arrives at the chamber at the small end of the revolving part of the turbine. The steam passes along to the right through the turbine blades, passing through a series of fixed blades which deflect it in one direction, thence striking the moving blades of the turbine, which deflect it in the opposite direction, and so on. In this way the current of steam impinging upon the moving blades drives them around. The areas of the passages increase, progressing in volume corresponding with the expansion of the steam. The turbine in question with its generator is 33 feet, 3 inches long, 8 feet, 9 inches wide, and weighs 175,000 pounds. Since the installation of the machine a number of tests have been made, which are said to show a steam economy of the most remarkable character, and an efficiency so high as to leave no doubt in the minds of those who are operating it that it represents the coming type of steam prime mover for central station purposes. It is readily started and its operation is quiet and free from vibration. It is significant that steam turbines are to be adopted by the Metropolitan Railway Company and and the Metropolitan District Electric Traction Company, of London, England. The station of the former company will contain three sets of 3,500 kilowatts capacity each, and that of the latter four sets of 5,000 kilowatts each. As with the Hartford plant, steam will be generated in water-tube boilers. These installations clearly indicate that the steam turbine has been received with favor and that it is likely to be quite generally adopted by central stations in the near future.

The time for receiving tenders for the installation of a telephone system in the city of Ottawa expired on May 29th. It is understood that the only offer received was submitted by Mr. O. W. Rogers. The city called for tenders without furnishing any specifications.

G. N. W. TELEGRAPH COMPANY, QUEBEC.

It appears that the business of the G. N. W. Telegraph Company in Quebec has been steadily increasing for the past three years, and the staff of employees has been growing larger, until there are now over fifty names on the pay rolls, and the operating room has been enlarged to double its former capacity. Two years ago there was only one "quadruplex" instrument in use in the office, and it was found sufficient for the requirements of the business. During the past three years the business has so materially improved that it has been found necessary to establish four additional quadruplex circuits.

Mr. Edwin Pope,
Manager G. N. W. Telegraph Company, Quebec.

In the last two years the company erected an additional wire between Quebec and Montreal, and another, of the largest gauge, between Quebec and Moncton, to accommodate the traffic with the cables and with the Lower Provinces, and an additional wire was put up between Quebec and Murray Bay to improve the connection with the Government lines extension to the Straits of Belle Isle. They also completed a first-class line along the route of the Great Northern Railway to Hawkesbury, and put up another wire on the Quebec & Lake St. John Railway, to meet the rapid development of the districts traversed by those two Quebec railways. Additional wires are also contemplated for the districts east of Quebec.

The enumeration of the wires worked by the company between Quebec and Montreal is an illustration of the great facilities which it has for despatching the messages entrusted to it. On the Canadian Pacific Railway they have four wires carried by two separate lines of poles, the same accommodation on the Grand Trunk, and on the Intercolonial Railway and Great Northern Railway respectively two wires and one line of poles. There is a single line of poles and wire along the highway on the north shore, and a similar line on the south shore, making in all 8 lines of poles and 14 lines of wire.

Direct communication is had with Montreal, Sherbrooke, Hawkesbury, Ottawa and Toronto on the west, and with Bersimis, Chicoutimi, Gaspe, Campbellton, Moncton, St. John, and Halifax on the east. All the signal stations on the St. Lawrence are also in direct connection with Quebec, to the great advantage of the shipping interests.

One of the most interesting parts of the telegraphic apparatus is the battery by which the numerous wires are operated. A current from the power house of the Quebec Railway, Light and Power Company at Montmorency operates an electric motor in the telegraph building, which in turn operates two dynamos specially built for the work, and these dynamos charge some five hundred cells of storage battery. Thus the energy and power of Montmorency Falls, after various alterations, is sent out in every direction for hundreds of miles and reaches points in four different provinces.

The head offices of the G. N. W. Telegraph Company are in the "Telegraph Building," 83 St. Peter street. Mr. Edwin Pope, of whom a portrait is shown, is local manager.

THE BELL TELEPHONE COMPANY, QUEBEC.

The Bell Telephone Company's Quebec Exchange is situated at the corner of St. John and St. Angele streets. The building was erected in 1898, and the Exchange was installed in March, 1899. The switchboard is of the type known as the "Branch Terminal Multiple Switchboard," with self-restoring drops. With regard to the electrical features, commencing at the basement, the subscribers' lines enter the building in cables of 150 pairs of wires each, all cables entering the building underground. These lead covered cables are potheaded, and rubber covered flexible ends are run from the potheads to the arrester side of the main distributing rack. The rack is an open iron framework. To the arrester side of the rack the flexible cable ends from the potheads are connected, while to the other side are connected the cables leading to the switchboard. The arresters used on the main distributing rack are a combination to protect against lightning and "sneak" currents. The lightning arrester consists of two plates of carbon separated by a ring of mica; lightning or other high potential currents will jump the air gap to ground without passing through the switchboard. The "sneak" current protector is somewhat more complicated, consisting of a small coil of German silver wire, wound on a hollow brass spool, a short pin passing through the hole in the spool, being held in place by a drop of fusible alloy, the whole mounted in a rubber case. This contrivance is held between two springs. When a current greater than the switchboard apparatus will stand commences to flow in the circuit, the spool heats, melting the alloy and releasing the pin, thus grounding the line, and cutting off the heavy current from the switchboard. The two sides of the rack are connected together with jumper wires. At this rack are made all changes due to new work, removal of instruments, changes in location of instruments, etc.

Leaving the main rack, the lines pass, in cables, upstairs to the switchboard, which consists of 18 subscribers operators' positions, two in-coming trunk positions and two long distance positions. The ultimate capacity is 3,000 subscribers' lines and 120 out-trunk lines. The present equipment is 1800 subscribers' lines, 60 out-trunk lines, 30 in-trunk lines, and 20 long distance lines. The woodwork of the switchboard is polished mahogany.

The subscribers' lines and the out-trunk lines are multiplied every six panels throughout the board, so that each operator can easily reach any number in the Exchange. The multiple is carried to the long distance positions, thus doing away with a switching operator. The in-trunk lines are controlled by signal lamps in front of the in-trunk operator.

Mr. H. A. Dauphin,
District Manager ell Telephone Company, Quebec.

The self-restoring drops, transmitters, lamp signals, etc., are operated from a four and two volt circuit, power for which is obtained from storage batteries. The storage batteries are connected up in multiple series, three in series, two in multiple, so as to give a difference of potential of two or four volts. The generator for charging the four volt storage battery is belted to a 500 volt, 3 h.p., two-phase induction motor. This four volt circuit is charged and discharged at the same time, the generator being designed so as not to introduce any disturbance in the transmitter circuits while charging.

The trunk signals and pilot lamps are operated from a 20 volt circuit. The generator for charging these batteries is also driven by an induction motor. The ringing current is obtained from a ¼ h.p. ringing generator driven by a small induction motor. The machines and power circuits are controlled by an elaborate power switchboard, the switches, etc., being mounted on a polished marble slab.

The very best material and workmanship have been employed throughout, and the Exchange compares favorably with any Exchange of this discription in the world. In this Exchange and the branch in St. Roch's suburbs, which has similar equipment and apparatus, over 2,000 subscribers' wires centre, whose average calling rate is ten calls per day, or a total of 20,000 calls daily.

Submarine telephone cables laid opposite the city connect with Levis and the South Shore, while another submarine cable from Cap Rouge to Etchemin provides an outlet to New Liverpool, Chaudiere and Beauce Districts. These cables in the first instance are extremely costly, and subject to frequent interruptions from ice pressure, anchors on drifting ships and rocky river bottom, which on account of the constant tidal and current motion wears the armour away.

THE A. I. E. E.

The nineteenth annuel meeting of the American Institute of Electrical Engineers was held in New York on May 20th. The reports presented showed a net gain in membership of 239 during the year and an increase of $14,844.48 in net assets. Charles F. Scott, of Pittsburg, Pa., was elected president for the ensuing year. Mr. Scott is chief electrician for the Westinghouse Electric & Manufacturing Company and has been a member of the Institute since 1892. Papers were presented on "Some Notes on European Practice in Electric Traction with Three-phase Alternating Current," and "A Novel Combination of Polyphase Motors for Traction Purposes."

View of Shawinigan Falls, Quebec, on St. Maurice River and Great Northern Railway.

Break Neck Steps, Quebec.

Little Champlain Street, Quebec.

NATIONAL ELECTRIC LIGHT CONVENTION.

The annual convention of the National Electric Light Association was held in Cincinnati, Ohio, May 20th to 22nd. The attendance was about 550, the largest in recent years. The Canadian representatives were : Frederic Nichols, Toronto ; P. G. Gossler, W. McLea Walbank, Alfred Colyer and R. S. Kelch, Montreal ; A. A. Dion and John Murphy, Ottawa; C. B. Hunt, London.

An address of welcome was extended to the visitors by General A. Hickenlooper, president of the Cincinnati Gas & Electric Company, and acknowledged on behalf the Association by Mr. Frederic Nichols. The programme was a departure from former methods insofar as long papers on technical subjects were eliminated and short written discussions on subjects of practical importance to central station managers substituted therefor.

The president, in his address, pointed out that the greatest opportunity for increasing the earnings of central stations lay in the development of markets. He said that recently a manufacturer gave a bid on a steam turbine, direct-connected to an alternating-current generator, with a guarantee of steam consumption which would be almost equal to ten pounds of steam per indicated horse power in our old type engines. He announced himself in favor of the metric system of weights and measures and denounced municipal ownership. Ninety per cent. of all the municipal plants which had been installed had proven rank failures. Many of them had been abandoned, and many others of them would be disposed of if the taxpayers really knew the results obtained in these plants. Regarding the development of a market, the president stated that central stations only sold from ten per cent. to thirty per cent. of the amount of current they were capable of generating, and plants were practically idle for about 70 to 90 per cent. of the time. While it was not possible to acquire a daily uniform load, he thought station managers could greatly influence the load factor of their stations by the class of business they encouraged. Line, meter and transformer efficiency had often been so low in alternating current stations that the stations were paid for but from 35 to 65 per cent. of the current sent out, and even then the cost of lost current in alternating stations was not as great as the additional interest charged in direct-current stations. It was simply absurd ever to expect to develop the central station business properly as long as charges are made only on the basis of current consumed. In conclusion the president urged that more consideration be given by central station men to underground construction.

A number of short and interesting papers were read, including the following : "Performance of the Present 220-volt Lamp," by F.W.C. Bailey, Columbus, Ohio ; "Three-Phase vs. Two-Phase for City Distribution," by B. H. Behrend, Cincinnati, and C. F. Scott, Pittsburg ; "Possibilities of Sign and Decorative Lighting," by E. J. McAllister, Newark, N. J.

The afternoon of Tuesday was devoted to a discussion of lamp efficiency and lamp renewals, short contributions on these subjects having been submitted by several of the members. L. A. Ferguson, of Chicago, said that he believed that the time was coming when an eight candle-power lamp would be the standard in this country rather than the sixteen candle-power. There was a discussion on the "Nernst Lamp," "Steam Turbines," "Hot Water vs. Steam Heating," and other subjects.

A visit was made to the new factory of the Bullock Electrical Manufacturing Company, situated in a suburb of Cincinnati. It was decided to hold the next convention in Chicago in May, 1903. Lewis A. Ferguson, of Chicago, was chosen president of the Association, and P. G. Gossler, of Montreal, was elected as a member of the Executive Committee.

A new scale of membership was adopted, to take effect in January, 1903. All members admitted after that date will be required to pay an initiation fee of $25. Annual dues after that date will be fixed as follows : For members from cities having 20,000 population or less, $10 ; 20,000 to 300,000, $25 ; over 300,000 $50.

The Consolidated Electrical Company, of Toronto, is arranging for a factory at St. Catharines, Ont. The company have a capital stock of $100,000.

Laborer (waving flag)—"Yez'll hav ter turn back. This sthreet's closed." Driver—What's it closed for?" Laborer—"Bekase it's jist been opened be the tillyphone company ter put down their wires. That's why it's closed,"—Philadelphia Press.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,

MONTREAL, MAY 24TH, 1902.

The late strike, in which an attempt by a Union to get increase of pay, shorter hours, and a recognition of the Union, proved a disastrous failure. No doubt some of the "outside construction" men had grievances in the way of pay, they claiming that as the city paid $1.50 per day for snow-shovelling, that anything less was not commensurate pay for climbing poles among 2000 volt live wires, etc. Further, that men doing similar work got better pay in other cities, such as Toronto. Some employers retort that no other city but Montreal, which is noted for its municipal extravagance, would pay $1.50 for shovelling snow. Be that as it may, the strike was badly advised, badly handled, and totally unnecessary, in fact was like 99 "strikes" out of 100, "bungled". However, as the men have gone back to work it is to be hoped that the companies will now investigate the wages question and prove the foregoing remarks. The nine hour clause, it is to be earnestly hoped, will be put in force soon by all, not only to benefit the employees but also the employer, but, mark you, not necessarily at 10 hours' pay for 9 hours' work.

The union agreement, to which signature was properly refused by companies and contractors alike, was simply preposterous. No business man or corporation could expect to run (except into insolvency) unless by managing their own affairs. The laborer is worthy of his hire and can surely obtain it some way without putting the general public to the discomforts of a "strike".

During the strike it was wonderful to see the interest the civic fathers took (suddenly) in electrical workers. A vote is a vote !

Tenders are in for an electrical pumping plant for Montreal upper reservoir pumping station, and at this juncture it behooves some wise acre to rush into the daily press to say that a 500 volt series D. C. motor run off a trolley in some New Brunswick hamlet was a failure and for Montreal to beware! It did not prove a success pumping municipal water, hence Montreal's will also be a failure. We happen to have a motor, and a good big one too at that, doing just such work already.

The underwriters have notified all cold storage people in Montreal that they must either put their wiring in conduit or submit to an extra 25 cents per $100 on insurance, besides being inspected every three months. Although cold storage wiring is proverbially bad, this action seems rather drastic, being the outcome of a fire at a cold storage warehouse, caused, however, by transformer breaking down and throwing 2000 volts into the building. What if some owners go back to coal oil stable lanterns? Are they not more dangerous?

Montreal is speaking of having its streets sprinkled electrically, i.e., by the Montreal Street Railway Company, instead of by the present primitive one-horse water carts. Quebec has done this for some time, the Quebec Electric Railway Company having some cars specially adapted for the work. Montreal, although to the fore in many matters, is considerably behind Quebec in this one.

There is an extensive but yet unfilled demand for an alterating current fan motor of small type for private house and sick room —one that will not give much wind; will run noiselessly at slow speed, so that if need be can be left running all night without keeping its owner awake. Some of the manufacturers of the excellent office fans now on the market might give us one more step in the speed control to suit above requirements.

The following persons known to the electrical fraternity were in Montreal recently: Mr. John Carroll, former manager Eugene F. Phillips Electrical Works and now representing Stuart, Howland & Company, of Boston, and the New England Electric Manufacturing Company, also of Boston; Mr. P. H. Hover, representing New York Insulated Wire Company; Mr. H. W. Baven, representing Western Electric Company, New York; Mr. H. E. Monk, representing W. R. Ostrander & Co., New York.

It is not like usual Yankee astuteness to flood the Canadian electrical trade with circulars and price lists of Canadian and India mica. The former, naturally, we can procure, with extreme facility, although our U. S. neighbors do control two or three of our mines—"there are others". As to India, surely England is our better market for such, not to speak of the chances of preferential tarriff applying also.

Surely there is an opening in Canada for one of our various rubber companies to turn out "decent" hard rubber such as can be turned up and used for electrical purposes,

LINING UP SHAFTING.

By Joseph E. Lewis.

The following method of lining up shafting seems to be known by very few engineers: Referring to Fig. 1, A is a straight-edge, which may be made from a piece of pine board about 4 feet long. It must be rigidly supported by uprights, from the floor, or otherwise, as is most convenient, so that the top is at the height of the centre of the shaft. Bring the straightedge to the true horizontal by the use of a spirit level and fix it securely in place. For short lines of shafting it may be located at one end, for long lines at the middle. On each rafter that supports a hanger, nail a short stick B, with one nail, so that it may be swung up out of the way when not in use as shown in Fig. 2. The bottom ends may all be brought into line by sighting carefully along the straightedge. For long lines sight in both directions from the middle. The ends of these sticks will also lie in the same horizontal plane at the height of the center of the shaft.

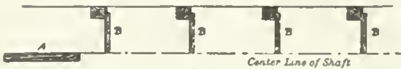


Fig 1

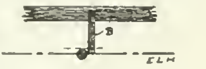


Fig 2

The hangers may now be put up and the shaft placed in position and adjusted to the true level by testing each bearing. For this purpose the sticks B may be turned down as shown in Fig. 2, and the center of the shaft brought to the level at each bearing. This may easily be done by the eye. To test the result, a small spirit level may be laid across the top of the shaft and a line drawn on B as shown. The distance from the end of this line to the end of B should be just one-half of the diameter of the shaft. The sticks should be turned up out of the way and left where they are, so that the alignment may be tested at any time.

Having adjusted all of the bearings to the same horizontal plane, we may now test them on the vertical plane. This is easily accomplished, whether the pulleys are in position or not. We will suppose that they are, and that the shaft varies from 3" nominal, at the middle, to 1¼" at the ends. Take two pieces of string and tie a nut to each end of each piece. Throw one piece over the shaft near the bearing at one end and the other piece at the other end. See Fig. 3. Now stretch a stout cord C from one end to the other, low enough down to clear the pulleys. The end of the cord should be brought exactly central between the two ends of the string hanging over the shaft. The weights may be kept from vibration by allowing them to hang in a pail of water. A small pail of oil is better yet, since its great viscosity more readily checks any motion. Having pulled the ine C taut in the correct position, it is an easy matter to adjust each bearing by throwing the string with the nuts on the ends over the shaft at the bearing to be tested, and adjusting the set screws until the line C is exactly central between the two ends of the string. You will notice that variations in the size of shafting do not hinder this operation in the least as is the case when a line is stretched at one side and attempts are made to measure in from it to the shaft; and furthermore the presence of the pulleys is no objection whatever. Any shaft may be tested in this manner during the noon hour, except when the belts interfere with line C. Where this is the case sufficient time must be allowed to remove such belts as are in the way.

If the shafting was put up with sticks, as above explained, it may also be tested for the horizontal plane in a very few moments. If the sticks are not in position, and it is desired to test the alignment of a shaft already up, it is possible to run the line below the pulleys in the manner shown by Fig. 1, the ends of the sticks B being brought down to this plane. Now, starting at any bearing the exact center of the shaft is marked on the stick. To be accurate a small spirit level may be used to mark across top and bottom, see Fig. 4, and the space thus marked off divided in half to get the exact center. Measure carefully the distance to the end of the stick from this center line and cut a measuring stick to just that length. Use this to make a simila. line on each of the other sticks B. One of these sticks will be located at each bearing and the center of the shaft may be readily brought to the line. All of the sticks may now be sawed off the right length and swung up out of the way for future use.

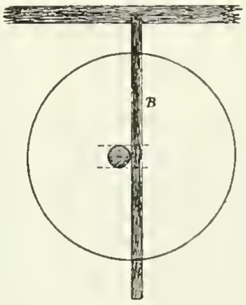


Fig 4

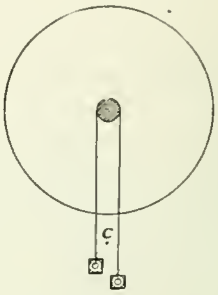
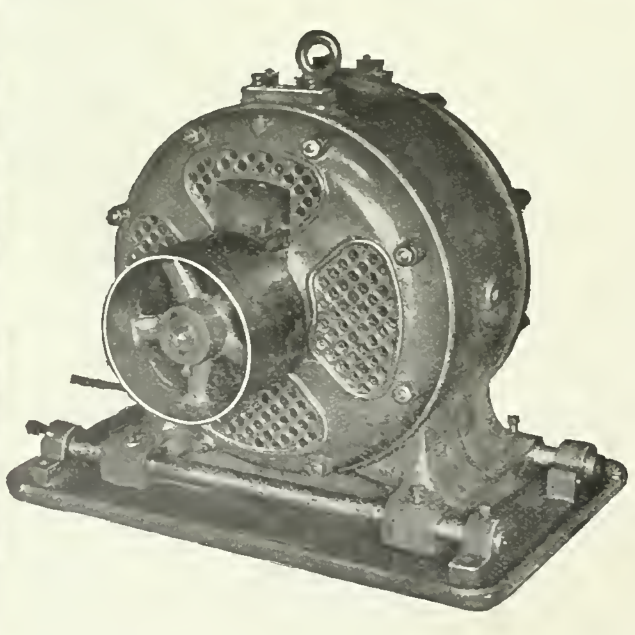


Fig 3



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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XII. JULY, 1902 No. 7.

THE OTTAWA ELECTRIC COMPANY.

We have received a copy of the eighth annual report of the directors of the Ottawa Electric Company, which was submitted at the annual meeting held on June 30th. The report says: "The completion of the new power house with its more modern system of generating and distributing electrical energy has enabled the management to effect the contemplated economies with most pleasing results, as a reference to the accompanying statements will show, notwithstanding that it was only possible to put the majority of such economies into full effect during the latter half of the year, dating from the opening of the new power house on the 16th November last.

MR. K. B. THORNTON, 2nd Vice-President. MR. B. F. REESOR, President. MR. EDWARD SLADE, 1st Vice-President.

OFFICERS OF THE CANADIAN ELECTRICAL ASSOCIATION FOR 1902-3..

"The Company's operations for the past year show a gross revenue from all sources of $227,634.83, being an increase of $31,271.61 over the previous year after making liberal provision for bad and doubtful debts.

"The gross cost of operating and maintenance was $115,244.02, leaving a profit of $112,390.81, from which profit is deducted $25,913.38 for interest paid upon bonds and current liabilities, leaving the net profit $86,477.43.

"The precentage of maintenance and operation to gross receipts was practically 50 per cent. Your Directors deem it important to mention that a considerable amount of work done during the past year in the nature of permanent improvements which was charged to Operation and Maintenance, might properly have been considered as capital expenditure. An amount of $75,000 has been carried to Depreciation Account, to provide for wear and tear and general depreciation of plant. Your attention is respectfully called to the continued increase of installations, and in the number of customers.

The following statistical statement shows the growth of the Company during the past three years:

Total Number of	30 April 1900	30 April 1901	30 April 1902
Lights "Incandescent"	87,114	93,207	104,407
Lights "Arc"	644	650	752
Heaters	23	17	24
Motors	103	133	157
Customers	4,357	5,208	5,820

The directors, at a subsequent meeting, elected the following officers: T. Ahearn, president; F.P. Bronson, vice-president; D. R. Street, secretary-treasurer; A.A. Dion, general superintendent; A. Bayly and R. Quain, auditors.

Never advertise without a definite purpose in view—let that purpose be the intreasing of trade in some particular branch of your business.—The Adviser.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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South African Trade.

WITH the ending of the war in South Africa will come a period of great development in that country and a consequent demand for many lines of manufactured goods. German and Austrian syndicates are said to be forming to exploit the South African market. With cool audacity the continental countries which as far as possible supported the Boer cause and obstructed the British are now seeking to reap the commercial advantages arising out of the conditions established by Great Britain at an enormous cost in men and money. The United States have been exporting largely to South Africa and their trade returns for the first half of this year show a substantial increase above the same period of 1901. It seems only fair to her own interests that Great Britain should impose some restrictions in the form of duties on foreign goods entering the South African market, thereby giving a preference to home and colonial industries, which will have to bear a considerable proportion of the expenses of the war, and compelling foreign countries to pay something for the commercial advantages which are the direct result of the long continued and successful struggle conducted by Great Britain. Canadian exporters of manufactured goods should lose no time in establishing trade connections in South Africa, and should be properly represented at the South Africa, British and Colonial Industrial Exhibition to be held in Cape Town, from Nov. to Feb. 1903-4.

The Canadian Electrical Association

WE have the pleasure to record another successful meeting of the Association and a further step forward in the direction of increase of membership and influence. The convention held in Quebec last month in some respects proved a surprise of a very agreeable character. In view of the distance to be travelled it was not expected that the attendance would reach the usual standard. On the contrary it exceeded all previous records by at least 25 per cent. The papers were of a very high standard, and treated of interesting phases of electric light and power and street railway engineering. Several of them were illustrated by means of specially designed apparatus the transportation and fitting up of which involved a great deal of labor and not a little expense. Several of these papers are printed in the present number and though lacking their full interest by reason of the absence of the explanatory apparatus, will amply repay careful reading. Much value attaches also to the discussions arising out of papers, reports of Committees and resolutions. There ought to be a large representation at future Conventions of the electric light and power companies to whom the Association has been of most benefit. It will pay every such company doing a business of moderate proportions to have a representative present at these yearly gatherings. By so doing they will be able to compare notes with and derive large benefit from the experience of men in their own line of business. Several private companies as well as corporations operating Municipal plants have already seen the wisdom of adopting this course, and no doubt the number will increase year by year. The well-known hospitality of the citizens of Quebec was manifested in the courtesies extended on every hand to the visitors and particularly in the trips and social events so carefully planned by the Local Committee in association with the citizens. With the excellent list of officers elected to manage the affairs of the Association, the present year is certain to be marked by progress, and should terminate with another successful convention in Toronto next June.

Canadian Electrical Association

Proceedings of the Twelfth Annual Convention

THE twelfth annual Convention of the Candian Electrical Asssociation was held in the Assembly Hall of the Chateau Frontenac, in the City of Quebec, Que., on Wednesday, Thursday and Friday, June 11th, 12th and 13th, 1902.

The opening session was held on Wednesday at 10.15 o'clock a.m., when the President, Mr. P. G. Gossler, of Montreal, occupied the chair and called the Convention to order.

The following persons were registered as being in attendance :

Fred. Thomson, G. R. Duncan, D. Sleeth, J. P. Thomson, F. W. Fairman, F. H. Leonard, Geo. C. Rough, K. B. Thornton. P. G. Gossler, A. Esling, Cecil Doutre, A. P. Horner, F. John Bell, D. W. McLaren, C. W. Henderson, Geo. W. Sadler, Alfred Collyer, G. M. Wight, A. S. Forman, W. V. Warren, J. A. Burns, W. F. Dean, Geo. H. Olney, H. W. Weller, L. J. Belnop, A. Milton Smith, W. L. Macfarlane, R. A. Stinson, T. W. Casey, J. H. Lachapelle, Montreal, Que. ; P. J. Begin, D. E. Blair, Edward A. Evans, L. Dennis, W. H. Wiggs, Guy H. Simpson, G. Hartman, Edwin Pope, Edward Slade, Lewis Burran, Arthur P. Doddridge, George Reed, P. H. Ga'e, G. U G. Holman, Charles W. Ross, William Langford, H. A. Dauphin, Thomas W. Kell, G. A. Montgomery, John James, Frank Carroll, Quebec, Que.; A. A. Dion, W. G. Bradley, Thomas Hilliard, M. Mavaut, A. A. Couvrette, Ormond Higman, T. Ahearn, Warren Y. Soper, James D. Fraser, C. W. Henderson, Ottawa, Ont.; J. J. Wright, Acton Burrows, H. G. Nicholls, W. Nicholls, Geo. W. Watts, J. W. Campbell, H. A. Moore, E. D. McCormack, Frank C. Smallpiece, W. McLeish, C. H. Mortimer, R. A. Stinson, Geo. Angus, A. B. Lamb, jr., Archibald B. Smith, T. F. Dryden, E. B. Biggar, E. Irving, Toronto, Ont.; R. T. Lozier, Russell Spaulding, J. C. Schaeffer, H. W. Bliven, P. H. Hover, Charles J. Marsh, Wm. B. Wreaks, New York ; W. D'A. Ryan, C. M. Green, Lynn, Mass.; L. G. Bassett, A. L. Tucker, W. B. Hale, Chicago, Ill.; Edward L. Reynolds, C. M. Wilkins, Philadelphia, Pa.; Frank G. Bolles, Cincinnati, Ohio; F. Schweetman, St. Louis, Mo., G. H. Berg, Boston, Mass.; Percy H. Thomas, Pittsburg, Penn.; A. A. Wright, Renfrew, Ont.; J. E. Skidmore, Cobourg, Ont.; B. F. Reesor, Lindsay, Ont.; D. W. Tully, Chateauguay Basin, Que.; F. W. Martin, St. Catharines, Ont.; S. E. Fletcher, Irving Smith, St. Johns, Que.; A. Sangster, R. N. Robins, Sherbrooke, Que.; John Yule, Guelph, Ont.; H. O. Fisk, Peterborough, Ont.; L. A. Cosgrave, Chicoutimi, Que.; J. W. Purcell, Walkerville, Ont.; A. C. Read, Levis, Que.; J. Camille Pouliot, Fraserville, Que.; V. B. Coleman, Port Hope, Ont.

The President: I now declare the Convention open for business. We have with us Alderman Tanguay, who has kindly consented to make a few opening remarks to the Convention. I have the honor of introducing Alderman Tanguay to the Convention. (Applause.)

Ald. Tanguay: Mr. President and Gentlemen: His Worship the Mayor being prevented from meeting you this morning on account of a previous engagement, I have the honor as pro Mayor of the City of Quebec to welcome you to this city. The Mayor asked me to express his regret at not being able to be here this morning. He would like very much to meet the gentlemen who compose so important an organization. I welcome you to our city with great pleasure and I hope you will enjoy your short visit amongst us; I trust you will be interested in following the programme that has been so well prepared, and I believe you will enjoy our hospitality which we give you with great heart. I thought of asking Captain Penny, our Chief of Police, to come and meet you this morning to offer you his services. (Laughter.) I must tell you that Captain Penny, in his capacity of Chief of Police, can be of great service to you, but can be otherwise too. He knows the city; he is what you might call a child of Quebec, he knows every corner and interesting spot, and besides I must tell you that you will find him very obliging. Gentlemen, once more I trust you will enjoy your short stay amongst us, and I hope I may have another opportunity of meeting you. I wish you all the best time possible. I thank you for your attention.

The President: I will call upon Mr. Dion to reply to Alderman Tanguay's kind welcome.

Mr. Dion: Alderman Tanguay, on behalf of the Canadian Electrical Association I thank you, and, through you, the Council and citizens of the City of Quebec for the very generous welcome you have just extended to us. We count it an honor and a privilege to meet you, Sir, and we esteem it a very great pleasure to assemble in your beautiful and very interesting city. Among the many attractions which draw towards this place, not the least are the magnificent electric installations which have been placed here within the last few years and which place your city in the very front rank amongst Canadian cities. The hospitality of your people, Sir, is proverbial, and we have no doubt that after our stay here a few days with you, we shall leave your city with regret, and shall carry with us the most pleasant memories of this Convention. I should also express my thanks for your consideration in having arranged to have the police tied up while we stay in the city. (Laughter and applause.)

The President: Following out a matter of custom and not complying with the Constitution I have prepared a few remarks addressed to the gentlemen and members of the Canadian Electrical Association:

PRESIDENT'S ADDRESS.

Gentlemen and Members of the Canadian Electrical Association:

It gives me much pleasure to meet you all on this occasion of the twelfth Annual Convention of our Association. It is particularly appropriate that we should meet here in this historic City of Quebec, which is so intimately associated with not only the early history of the settlement of this continent, but also with the very early history of the development of electric power transmission in Canada.

That part of the business ot this country with which so many of the members have been and are now intimately and prominently associated, namely, the development and operation of water power plants for electric transmission, was greatly encouraged in its early stages by the successful utilization of Montmorency Falls for lighting and power purposes.

We have on all sides of us in this city abundant proof of the continuance of the courage, foresight and energy which must necessarily have been characteristic of those who promoted and brought to a successful completion such an undertaking as the transmission of electric power from Montmorency Falls, at a time when high tension apparatus and lines used for the supply of commercial light and power were looked upon by the general public with some doubt, and considered, by many, as being an experiment.

It is only necessary for us to inspect the power houses, substations and electric railways in and around Quebec to make us realize what tremendous strides have been made throughout the country and here in this very city in the utilization of electricity since the installation of the Montmorency plant which, I think I am safe in saying, was the first high tension system put into commercial use in this country.

It is, therefore, apparent why Quebec is an ideal city for a Convention of an electrical association, for no place else could this extraordinary progress be more emphatically contrasted. We have here an excellent opportunity of seeing modern power plants, supplying current for all branches of industry, and of acquainting ourselves with the successful solution of some of the problems of long distance, high tension power transmission.

It is to be regretted that the programme for this meeting could not include a visit to all of the power houses in the city or immediate vicinity, but those who have the time will be amply repaid by visiting them. The local committee have provided so generously for our entertainment that it has been impossible to include on our programme all of the many attractive features offered.

The Association is to be congratulated on the sound and healthy condition in which this Convention finds it. The Report of the Secretary-Treasurer shows that we have a surplus in the Treasury sufficiently large to meet all of our ordinary requirements and to enable us to carry out any work which we may think wise to inaugurate; and the steady increase in membership gives strong evidence of the life and vitality of the Association itself.

One of the objects of the organization, as set forth by the Constitution, is to promote the interests of those engaged in any electrical enterprise; to successfully secure this object, its influence must be far-reaching, and all companies, firms and persons interested in the electrical industries should be related to each other through the medium of the Association.

The steady increase in membership in the last few years, and the very marked widening of interest in the proceedings, justifies us in expecting that within a comparatively short time, every company or person interested in the electrical industries in Canada will be represented on our membership roll.

At the last Convention there was an amendment made to the Constitution, whereby membership was divided into several classes. While this amendment provides that manufacturers are not eligible to active membership, I want to emphasize that this Association wants and requires the cooperation and assistance of the manufacturers.

A report of a largely attended meeting of the Executive Committee, held in January last, has been placed in your hands, and from it you will have noted the generous gift to the Association by one of our manufacturing members, which is a very substantial and material reminder of what help manufacturers are to the Association.

The Executive Committee decided to set this donation aside as a special fund, out of which is to be allotted a yearly sum to be awarded in prizes for papers presented before our Annual Convention. It is expected by this means to encourage members to devote more time to original work or to preparing for publication an account of any unusual or extraordinary results arrived at or work carried out by them or under their supervision.

The Committee having in hand the formation of a set of rules governing the awarding of this prize have not been able to put them in shape for the Convention, but it is expected that they will be completed and presented to the members before the close of the present session.

You will receive and have read the reports of the several Committees and you will have presented and discussed several excellent papers dealing with subjects of great interest and importance to this Association.

While the report of the Legislative Committee will state that no legislation was enacted during the past year that has counteracted the good results or broken down the proper and just safeguards placed around our business, and which owe their existence to the direct and strenuous efforts of this Association and its Committee; yet we must not lose sight of the fact that there is an under-current tending towards legislation which would deprive many existing Companies and much invested capital of their legitimate rights and protection.

I attribute this tendency on the part of some of the advocates of such measures to their ignorance of the business ; and their ignorance has not been very much enlightened by the opinions given to the public by some men identified, in more or less responsible capacities, with the electrical industries of this country. I deem it my duty to bring it to your attention that certain evidence has been given during the past year in arbitrations required by the Conmee Act, which cannot do otherwise than have the tendency to depreciate the value of plants below the point which, I am of the opinion, would be approved of by this Association. I have reference to such statements as tend to confuse the mind of the public, and give the impression that the value of a plant is that for which it could be replaced at the present day by new equipment, no consideration or value being placed upon the fact that these pioneer organizations, by establishing that electrical companies were a commercial possibility and a means of making a fair return on the capital invested, have made it possible for construction and manufacturing companies to now install and supply equipment at figures much less than the prices of ten years ago.

It is, therefore, the duty of this Association, in carrying out its obligations, to promote the interests of its members, that it discountenance and discredit such publicly expressed opinions, which may have a tendency to put other than fair value on the properties of electrical companies.

I would call your special attention to the Report of the Committee to Confer with the Board of Fire Underwriters from which it will be noted that there is an effort on the part of one of the largest cities in this this country, by the Board of Fire Underwriters to force upon the city the expense and responsibility of establishing a system of inspection for electrical installations. The Fire Underwriters of the United States, and, to a limited extent, in this country, have found it to their advantage to establish bureaus of inspection of their own and to control and operate them at their expense.

That an éfficient and thorough periodic inspection of all electrical installations is necessary and desirable, we will all agree, but the cost of this inspection must not be made a hardship to the customers of electrical companies : otherwise the rapid development and universal use of electricity for all purposes—commercial and domestic—will be hampered.

I am strongly of the opinion that the interests of all parties will be best served by having electrical inspection bureaus established and operated at the expense of the Fire Underwriters ; they have thought it advisable, for their own interests, to form a set of rules to govern the installation of electrical apparatus—why should they not see that these rules are enforced, especially as they have a most efficient means within their control of enforcing these rules, namely cancelling the policies on such properties when the electrical installations are not in accordance with the established practice or the Underwriters' rules.

We are in the midst of an era of great prosperity ; the expansion of the business of electrical companies during the past few years has never been equalled in the same time in any other industry, with the result that many of the companies have had more business at fair and profitable rates than they could conveniently handle. On the other hand, some of the companies, in their efforts to get business, regardless of the price at which they procure it, have so reduced their rates that it is questionable whether they are making a fair and profitable return upon their investment.

The time is sure to come when remodelling or reconstruction or expansion of business requires additional capital ; if provision is not made in times of prosperity to meet these conditions, it may be difficult in times of less prosperity to secure the needed funds ; it is, therefore, not advisable, for the sake of securing business, to reduce rates to such an extent that a proper return on the capital is not assured, otherwise you are courting self-destruction. There is a limit beyond which business competitors cannot go with continued safety to themselves without discrediting or reducing the profits of the very enterprises upon which their own prosperity depends.

A natural reduction in prices for lighting and power will be the result of developing business along lines being successfully advocated in some cities ; I refer to the limitation of the use of electric current for manufacturing purposes to the hours when there is practically no demand upon the supply station to meet the lighting requirements—in other words, to the daylight hours. The disadvantages of the peak load characteristic of practically all supply plants some years ago, and still of the majority of lighting and power plants, are known only too well to all of us.

A few years ago it was thought almost impossible to create and develop a commercial demand on a supply station supplying light and power, whereby the output would be practically constant during the ten hours generally referred to as "working hours." Yet this has been accomplished by a company with which I am associated in Montreal ; the ordinary day load of this company during the heaviest month of the year, namely, December, averages, between the hours of 7.00 a.m. and 6.00 p.m. from 90 to 94 per cent. of the maximum peak ; and you may be surprised to learn that this maximum peak load occurs with us between 6 and 7 o'clock in the morning when the city arc lighting overlaps the demand for power by the factories in starting up for the day.

The idea that it is profitable for many, if not all, manufacturers to work only during the daylight hours is gaining ground rapidly in Montreal and elsewhere ; the best evidence of which is the fact that contracts are continually being entered into which do not require the supply of all or part of the power during the hours when the need of illumination makes the greatest demand upon an electrical plant. By properly arranging the hours of work, a factory can comply with these conditions and yet not reduce the total number of hours of work per annum.

Power supplied to manufacturers under these limitations can be furnished at a cost very much less than they can ever expect to secure it otherwise, and at the same time there will be an additional demand for power created from sources heretofore incapable of being reached. This additional source of revenue will also permit of selling current for lighting profitably at a much less rate than when there is little or no requirement for the plant in the day time.

The papers to be presented deal with subjects of great interest and practical importance, and I solicit for them a full and thorough discussion. We are here principally to hear the views of members with whom we are not in constant contact, and to exchange ideas with each other ; let the discussion, therefore bring out all of the points not touched upon by the writers.

We are all engaged in an active and exacting business, and to prepare a Convention paper requires a considerable sacrifice of time. On behalf of the Association and the committee on papers, I desire to thank most cordially the writers who have complied with the request to present papers before this convention.

I desire to express my regret at not having been able to devote as much time to the affairs of the Association as I wished to during the past year, but the hearty support and co-operation of the Executive and other Committees and their attention to the matters entrusted to them has more than compensated for any lack of attention on my part.

I wish to thank you most cordially for the honor bestowed when you elected me your President, and for the support given me during the past year. I will close these remarks with the assurance that I will always have a warm interest in the Association and stand ready to be of any assistance to it whatever that it may be within my power to render.

The President: I have just received a note that there are 76 members and guests present in this room. I think the members may feel very much flattered. It is rather a long way to come.

The next order of business is the Secretary-Tresurer's report, by Mr. C. H. Mortimer.

Mr. Mortimer presented his report, as follows:

SECRETARY TREASURER'S REPORT.

The Association year which has just closed has been marked by a substantial increase in membership. The membership now stands at 306, a gain since last report of 39.

Members who may change their addresses are requested to notify the Secretary. Owing to neglect in this matter, communications addressed to several of our members during last year could not be delivered.

Immediately following our last Convention, the attention of the principals of the various scientific schools in Canada was called to the Student Membership established by the Association at the Ottawa meeting, with a request that they acquaint their students in electricity of the fact. I regret that thus far no interest has been manifested either by the managers or students of these schools.

The Legislation Committee held several meetings prior to and during the session of the Ontario Legislature, when legislation detrimental to the interests of electrical companies was threatened. Fortunately, however, no legislation in amendment to the Conmee Act, or otherwise inimical to the electrical interests, was enacted.

A well attended and important meeting of the Executive Committee was held at the Windsor Hotel, Montreal, on January 10th last.

An offer was received from Mr. Frederic Nicholls on behalf of the Canadian General Electric Company, of the sum of $500 to the funds of the Association to be applied as the Executive might decide.

On motion by Mr. W. H. Browne and Mr. J.J. Wright, the offer was accepted, and set aside as a special fund out of which will be allotted yearly a sum not exceeding $75.00 for original papers to be presented by members of the Association at the Annual Conventions. A Committee composed of Messrs. Dion, Yule and Sangster, was appointed to draft rules and regulations, subject to the approval of the Executive, under which the prizes will be awarded. To the Committee on Papers was delegated the duty of judging the merits of the papers submitted, and the President was authorized to suggest to the Executive a suitable Committee to award the prizes.

Eight active and two associate members were elected at this meeting.

Mr. G.U.G. Holman, on behalf of the electrical companies and citizens of Quebec, invited the Association to hold its Annual Convention in that city. On motion of Messrs. J. J. Wright and A.A. Dion, the invitation was accepted, and June the 11th, 12th and 13th chosen as the dates for the meeting.

Committees to complete arrangements were appointed as follows:—

Committee on Papers—Mr. K. B. Thornton, Chairman with power to appoint the other members.

Local Committee—Messrs. G.U.G. Holman, Edward Slade and Edward A. Evans, with power to add to their number.

Committee on Transportation—Messrs. J. J. Wright, Frederic Nicholls and Edward Slade.

On motion by Messrs. Holman and Sangster, the matter of special financial assistance to the Local Committee was left in the hands of the President with power to act.

The President was requested to communicate with Mr. Francisco and ask that Canada be included in his statistics of the results of the operation of municipal plants.

Having learned of the presence in Montreal of Mr. Marconi, the celebrated inventor of wireless telegraphy, the Committee, on behalf of the Association, tendered that gentleman an informal luncheon at the St. James' Club.

The Secretary was instructed to record in the Minutes the pleasure derived by the members of the Association from the visit of Mr. Marconi and his kind offer, if possible, to be present and present a paper at the Annual Convention. The Treasurer was authorized to liquidate the cost of the luncheon.

Following is a detailed statement of the receipts and disbursements of the Association for the year ending May 31st, 1902:—

TREASURER'S STATEMENT

RECEIPTS.

Cash in Bank June 1, 1901	$276.47	
Cash on Hand June 1, 1901	14.27	
166 Active Members' Fees $3	498.00	
25 Associate Members' Fees $2	50.00	
Donation from Can. Genl. Elec. Co.	500.00	
Refund of part of grant to Local Committee for expenses of 1901 Convention	100.00	
		$1438.74

DISBURSEMENTS.

Badges for 1901 Convention	$ 11.75	
Postage for 1901 Convention Programmes, etc.	20.00	
Exchange on Cheques	6.20	
Express Charges	4.84	
Telegrams	1.86	
Stationary	3.10	
Banquet Cards	1.00	
Assistant to Secretary	3.00	
Grant to Secretary	125.00	
Expenses attending executive meeting in Montreal (for Secretary)	20.00	
Convention Expenses (grant to Local Committee)	150.00	
Ottawa Agency & Messenger Co.	3.00	
Stenographer	40.00	
Luncheon — Tendered by Executive to Mr. Marconi	58.86	
Printing in connection with 1901 Convention, including 400 copies of proceedings	122.58	
Ribbon for Badges for 1902	2.10	
Printing Show Cards for 1902	4.00	
Postage	34.34	
Cash on Hand	34.83	
Cash in Bank	792.28	
		$1438.74

Mr. Dion moved, seconded by Mr. Reesor, that the report be received and that the Chair appoint the usual auditing committee to audit the financial statement.

The President put the motion which, on a vote having been taken, was declared carried, and Messrs. A. A. Dion and John Yule were appointed as auditors.

The President: The next order of business is the presentation of the reports of the Standing Commitees, and I will call upon Mr. Yule to present the report of the Committee on Legislation. I may say that the Committee on Legislation is one of the most important this Association has ever authorized to act in its behalf, and its work has been productive of most beneficial results, especially the protective legislation which has been enacted in the Province of Ontario. As yet there has been no unfriendly legislation enacted in Quebec, but it will come sooner or later, that is assured. At the recent Convention of the National Electric Light Association the matter of protecting the invested capital of electrical industries was taken up and the plans that were outlined as followed by the Canadian Electrical Association received considerable approval. I may say the State of Connecticut has followed almost identically the plans followed by the Legislation Committee of this Association. The legislation on this matter by the State of Massachusetts was before that time.

Mr. John Yule presented the report of the Committee on Legislation, as follows:

REPORT OF COMMITTEE ON LEGISLATION.

To the Canadian Electrical Association:

Gentlemen,—Your Committee on Legislation beg to report that during the past year they have given close attention to the interests of lighting companies in the department entrusted to their care by this Association. In looking back to the Niagara Falls Convention in 1897 when the movement was started to secure some measure of fair and just protection to the capital invested in Electric Companies, and knowing as we now do the extent of the agitation for Municipal control, it must be quite apparent to all and especially to companies in the province of Ontario that this Association has more than justified its usefulness and value. As this agitation has now developed into a socialistic propaganda of a far reaching nature, your Committee consider it will be a wise thing for the Companies interested to give a more active and liberal financial support to this Association if they value what has been accomplished in their interests. Our enemies are getting year by year more aggressive, and it will require constant watchfulness and work to hold what we have. Your Committee beg to be excused for repeating these arguments from time to time. We would be inclined to think it not necessary, but quite a number of companies have derived the full benefit of our work in the transfer of their properties to municipalities, who have not contributed one cent or given one hour's time in assisting the work of this Association. Your Committee earnestly hope and trust a more generous support will be accorded the Canadian Electrical Association in the future.

Reporting on the work of your Committee during the year, there was the usual grist of proposed amendments and new bills introduced affecting our interests. In the early part of the session deputations from municipal councils were in Toronto asking for changes in Section 35 of the Municipal Act, commonly called the Conmee Bill. At the urgent request of companies in the places represented by these deputations, the Chairman of this Committee took steps to counteract this movement, his action being approved by the Committee. The attacks made on Section 35 Ontario Municipal Act during the last session were not general but were made to appear as only affecting particular localities; of course if successful it would have affected the whole Province, Toronto and Rat Portage being the storm centres. As you already know the attempt on the part of Toronto City Council although strongly pushed was unsuccessful. What they asked for was power to purchase energy at Niagara Falls or delivered in Toronto; they further asked for power to develop water-power. Their Bill gave no estimate of cost or any particulars that would name a limit to the contemplated expenditure.

The Socialistic candidates in the election campaign last month all advocated the policy of the Provincial Government generating electricity at the Falls, transmitting and selling at cost to the different Municipalities. Whether this movement will grow or not the future will determine. We point this out for the purpose of showing the different lines of attack made upon our interests and the necessity of continued wakefulness on the part of the Companies.

In the case of Rat Portage a compromise was arranged that was satisfactory to the Company and Council.

The question of assessment on the properties of the Companies was also before the Municipal Committee and an amendment passed to assess on their value as going concerns, or on the price at which the properties could be sold to others who would continue the business. The different interests were represented by able counsel but the strong agitation throughout the Province in support of a more oppressive system of taxation than is adopted to other manufacturing concerns appeared to influence the Committee in coming to this decision. The whole question of the re-arrangement of assessment has yet to be dealt with and a modification of assessment on Electric Companies may be obtained but the outlook in this direction is not encouraging.

The total amount contributed during the year was $297.00; there was deficit carried forward from last year of $7.72, this left available funds of $289.28.

The disbursements and unpaid accounts amount to $119.36, leaving a balance on hand of $169.92.

The number of Companies and individuals who have contributed this year is 31. Last year the number was 23.

The following are the names of those who have contributed: Exeter Electric Light & Power Co.; Strathroy Electric Co.; Mr. Breithaupt, Berlin; Hamilton & Prout, Forest; St. Thomas Gas Co.; W. H. Birchard, Aurora; Henry Cook, Hensall; Guelph Light & Power Co.; Brantford Electric & Operating Co.; Glenwilliams Electric Co.; Smiths Falls Electric Co.; R. A. Corbett, Port Hope; Renfrew Electric Co.; Ottawa Electric Co.; Listowel Electric Co.; Midland Electric Co.; Joseph Knox, Stayner; Seaforth Electric Co.; Galt Gas Co.; Gananoque Electric Co.; Ingersoll Electric Co.; Merrickville Electric Co.; W. C. Harrison, Norwood; Petrolea Electric Co.; Simon Plewes, Creemore; Knight Bros., Burk's Falls; W. Moore & Son, Meaford; Welland Electric Co.; Wingham Electric Co.; Leamington Electric Co.; Citizens Light, Heat & Power Co., Rat Portage.

JOHN YULE,
Chairman Committee on Legislation.

Mr. Yule: I might say since I prepared this report a week ago we got notice in the newspapers that there had been already a movement started to form a syndicate to develop power at Niagara Falls and transmit it to Western and Central Ontario. Whether it is a movement to force the Government into that action or what direction it will take I do not know. I beg to submit for your consideration the report of the Committee on Legislation which I have just read. (Applause.)

The President: You have heard the report of the Legislative Committee, and as this deals with the most important matter that this Association has taken in hand I think since its inception, we not only should pay attention to the report but will have to keep our eyes and ears open in regard to all the local indications looking to prospective legislation. We will consider the report at a later meeting. I will call on Mr. Sadler to present the report of the Committee to confer with the Board of Fire Underwriters.

Alderman Sadler presented the report, as follows:

REPORT OF COMMITTEE TO CONFER WITH THE BOARD OF FIRE UNDERWRITERS.

To The President of the Canadian Electrical Association:—

The Convention of 1898 appointed a Committee to confer with the Underwriters with regard to the adoption of Permanent Rules Governing Electrical Installation.

The Committee made a report at the Ninth Convention held in the City of Hamilton, June, 1899. The substance of their report was that after several interviews with the Fire Underwriters, and a full discussion of the subject, it was held by the Underwriters, that they had not sufficient interest in the subject to warrant them in taking the matter up, especially if it entailed any extra expense to them of the appointment of an Inspector. The fires from electric wiring hazards did not warrant them incurring any extra expense.

The Association approved of the continuing of the Committee, but we are not aware of any further report having been made, or of any progress towards the appointment of an inspector of electric wiring, except that the City of Montreal a year ago in framing new building By-Laws, inserted certain rules governing electric wiring, and inserted a clause in this By-Law to the effect, that the City may appoint an Inspector, but nothing further has been done by the City. However, the subject has come up again by the action of the Fire Underwriters having on the 19th March 1902, sent a circular to the City Council of Montreal and caused the Montreal Board of Trade and Chamber of Commerce to also forward resolutions from their respective Boards, endorsing their action and urging the City to appoint an Inspector. Attached hereto are copies of these letters.

At the suggestion of your President we have undertaken to bring this subject before the Convention and report what has been done by the City of Montreal, since the receipt of these communications. The City Council passed them to the Fire and Light Committee, they were then forwarded to their electrician, Mr. F. H. Badger, to make a full report on the subject. At the present time Mr. Badger is visiting some of the cities in the United States with a view of ascertaining how the work is conducted there, and no doubt but his report will shortly be before the Council to take more definite action and decide whether they shall appoint an inspector or not.

There can be no question of the advisability of having an Inspector on Electric Wiring, but we would recommend that the work be divided into two classes: One pertaining to the wiring that is done outside on public highways and over roofs of buildings, the second the wiring inside the buildings.

With regard to the first there can be no question but that the city in the public interest and safety of the citizens and public in general, should have a supervision of the same and Inspectors.

With regard to the second, we cannot see who is interested outside of the proprietors and tenants of the buildings and Fire Underwriters.

We find on making enquiries that for some time back there has been established in Montreal an Electric Inspection Bureau. A Mr. W. J. Plews is the accredited Inspector of the Underwriters at this office. He issues certificates and collects a fee, but we cannot say if he receives any salary in addition, or what becomes of the fees. We attach to this report a copy of the certificates he gives which are printed in three colors,—white for the proprietor, blue for the insurance, yellow for the Inspectors' Bureau.

Thus it will be seen that the Fire Underwriters have been doing something in this line for their own protection, and we do not see any reason why they should not continue it, the question of expense to be settled between themselves and the parties they are inspecting for; of course it may be necessary to pass certain laws in connection with it.

We cannot discuss this question from an electrical point of view, but see sufficient in it to interest this Convention and leave the matter entirely for you, feeling sure you will take immediate steps to conserve the interests of the different companies supplying electric energy in the cities, and appoint a committee that may be prepared to meet the civic authorities to discuss this matter when it comes up later on.

[COPY]

Memorial from the Canadian Fire Underwriters' Association to the Council of the City of Montreal re Supervision of Electric Light and Power Wires and Installations.

To His Worship the Mayor and Aldermen of the City of Montreal.

GENTLEMEN,—The use of electricity and the very hazardous conditions under which it is transmitted and used in the City of Montreal, with the resultant most serious loss to life and property, force upon us the urgency of having placed under control, as far as possible, the methods and material by which it is applied. We would therefore respectfully bring to your notice the following:—There are at present operating in the City the following Companies using overhead wire systems:— Lighting and Power Companies using High Potential Wires—Citizens Lighting & Power Company, Gazette Printing Co., Imperial Electric Light Co., Lachine Rapids Hydraulic & Land Co., Ltd., Montreal Light, Heat & Power Co., Standard Light & Power Co., Montreal Street Railway Co. Telephone, Telegraph, Etc.—Bell Telephone Co., Ltd., Canadian Pacific Railway Telegraph Co., Great North Western Telegraph Co., Dominion Burglary Guarantee Co., District Telegraph Co., Holmes Electric Protection Co., Merchants' Telephone Co., McGill College Time Line.

The mass of overhead wiring used by these Companies, particularly in the business portion of the City, strung upon poles, crossing over and supported upon the roofs of buildings, is a constant menace to public safety. As a rule the congestion is greatest in the proximity of the properties of largest values. Many wires become dead lines through the removal of telephones, messenger call boxes, etc.; in time they break, and are thrown by the wind into contact with high potential wires and become the medium by which many fires are started in concealed places.

The greatest danger exists from crosses between high potential wires and other wires. These wires are a serious hindrance to the Fire Brigade in reaching the upper portions of buildings.

At present any person, whether competent or not, is at liberty to instal wiring for lighting and other purposes, consequently a considerable percentage of the interior work is done with poor material and in a faulty manner. Many buildings were wired some years ago, with material and under systems of construction which have since been proven to be dangerous and to invite destruction.

Indicating and proving the danger from overhead wires, we have on record among others the following instances:

Canada Life Building—Robtins. Appleton & Co.—High tension current entered over electric time circuit wires, formed connection with burglar alarm wiring, and caused fire to occur in material used in connection with safe protection.

Branch Bank of Montreal, corner of Seigneurs and Notre Dame Streets.—High tension current entered over burglar alarm wiring and burned out resistance coil, setting fire to woodwork in front of safe door.

Guarantee Co. of North America, Beaver Hall Hill.—High tension current entered over telegraph wires and caused incipient fire in vicinity of instrument.

Residence of the late W. W. Ogilvie, Esq. High tension current entered over wires connected with messenger call box, setting fire to wall in vicinity of same.

Douglas Methodist Church, corner Chomedy and St. Catherine Streets.—High and low tension wires, stretched across roof, sagged and made contact with iron frame of skylight, thereby allowing high tension current to enter premises on low tension service wires. Current arced to ground, by way of insulating joints, which were used to connect combination gas and electric fixtures to gas pipes, and at a place where a wire was improperly laid across a lead water pipe.

Cold Storage, St. Henry Street. —Transformer was faulty, and allowed the entire voltage to pass into the building, causing very heavy damages.

Residence of Hugh Paton, Esq., Sherbrooke Street. Primary and secondary wires touched, transmitted entire voltage around transformer, setting fire to the building and causing very serious loss. There were disturbances in two other houses in the immediate vicinity at the same time.

Guardian Assurance Co. Building, St. James Street. The Burglary Alarm central office was located in the basement, by a voltage of 220 by the Standard Light & Power Co. Fire resulting from excess current and destroyed building.

It is a fact that concurrently with the fire in this building there were disturbances at the following places all served by the same system: Ness, McLaren & Bate, St. James Street, desk burned, etc; James Dennison, 141 St. Peter Street, disturbance; John Fee, 623 Lagauchetiere Street, disturbance; C. P. R. Telegraph Building, general disturbance, and there may have been others.

Warden King, Craig Street.—The primary current passed over service wire, transmitting current into the building a man lost his life in consequence while attending the heating furnace in cellar of Dominion Foundry Supply Co.

St. Cunegonde—Alphonse Girouard.—Took hold of an incandescent lamp and died from the shock.

The above are a few instances among many that could be cited. The wearing and burning out of Transformers has frequently occurred. Electrial Experts have been consulted as to the conditions existing in the City, and they report them to be defective and hazardous to an extreme.

Having this knowledge, we earnestly request that steps be immediately taken by your honorable Council: 1st. To assume control of all wires and electric light and power apparatus within the City, and to regulate the quantity and voltage of current permitted to enter the City. 2nd. To have all light and power wires (and all others as far as practicable) placed underground, with the least possible delay. If the City has not the power to undertake or compel this, that they apply to the Legislature for same. 3rd. To require that protecting guards be placed over all trolley wires. 4th. To have dead wires removed without delay. 5th. To pass a law under penalty of which: a.—No transformer can be used that has not been inspected and approved of, and to provide for their examination periodically by competent and independent persons. b.—That all wires, conduits, and other material used be according to standard requirements. 6th. To have competent experts appointed as City Inspectors, as provided for in the Building By-Law, to see to the strict enforcement of the law contained therein regarding the use of electricity. 7th. To compel the production of certificates from the City Inspector, within a specified time by all proprietors, that the interior wiring is safely installed and in conformity with the standard rules. 8th. To take such other measurers as may be found necessary to fully protect life and property against the increasing dangers arising from the improper use of electricity.

Signed on behalf of the Canadian Fire Underwriters' Association.

JAS. McGREGOR, Vice-President.
ALF. W. HADRILL, Secretary.

MONTREAL, 19th March, 1902.

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THE MONTREAL BOARD OF TRADE.

Montreal, March 21, 1902.

To His Worship the Mayor and the Aldermen of the City of Montreal.

GENTLEMEN,—I have the honor on behalf of the Council of this Board to say that it has recently given attention to the questions of the dangers connected with the use of electricity for light and power, and that conference with the Underwriters' Association has convinced the Council of the hazards to life and property which have developed from the want of proper control of outside wiring and interior installation in this city. The Council therefore has unanimously endorsed the following requests which it understands the Underwriters are making to you.

That the City Council should: 1st. Assume control of all wires and electrical apparatus within the city, and regulate the quantity of voltage of current permitted to enter the city. 2nd. Have all light and power wires (and all others as far as practicable) placed underground, with the least possible delay. Should the city not have power to compel this that they apply to the Legislature to have it done. 3rd. Require that protecting guards be placed over all trolley wires. 4th. Have dead wires removed without delay. 5th. Pass a law under penalty of which :—(a)—No transformer can be used that has not been inspected and approved of, and to provide for their examination periodically by competent persons. (b)—That all wires, conduits and other material used be according to standard requirements. 6th. Have competent experts appointed, as provided for in the Building By-Law, see to the strict enforcement of the law contained therein regarding the use of electricity. 7th. Compel the production of certificates within a specified time by all proprietors, that the interior wiring is safely installed and in conformity with the standard rules. 8th. Take all other measures as may be found necessary to fully protect life and property against the increasing dangers arising from the improper use of electricity.

I have the honor to be, your obedient servant,

(Signed) GEO. HADRILL,
Secretary.

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LA CHAMBRE DU DISTRICT DE MONTREAL.

Having this knowledge, we earnestly request that steps be immediately taken by your honorable Council: 1st. To assume control of all wires and electrical apparatus within the City, and to regulate the quantity and voltage of current permitted to enter the City. 2nd. To have all light and power wires (and all others as far as practicable) placed underground, with the least possible delay. Should the City not have power to compel this that they apply to the Legislature to have it done. 3rd. To require that protecting guards be placed over all trolley wires. 3rd. We suggest that this clause be omitted as experience tends to prove that protecting guards, as used, are a cause of danger, either by increasing the number of wires in the streets or by loading unnecessarily the trolley wires with so-called protecting devices, which in countries where it has been adopted, has not rendered the services it was to do. 4th. To have the dead wires removed without delay. 5th. To pass a law under penalty of which: a: no transformer can be used that has not been inspected and approved of, and to provide for their examination periodically by competent and independent persons. b: that all wires, conduits and other material used be according to standard requirements. 6th. To have competent experts appointed, as provided for in the building By-Law, to see to the strict enforcement of the law contained therein regarding the use of electricity. 6th. To have certified electrical experts appointed, as City Inspectors as provided for in the Building By Law, to see to the strict enforcement of the law contained therein regarding the use of electricity. 7th. To compel the production of certificates within a specified time by all proprietors, that the interior wiring is safely installed and in conformity with the standard rules. 7th. To compel all proprietors to take permit before entering electric wires in buildings and to produce within a specified time a city inspector's certificate, that the wiring is in conformity with the standard rules. 8th. To take such other measures as may be found necessary to fully protect life and property against the increasing dangers arising from the improper use of electricity. 9th. No person to put up electric light apparatus in buildings unless he is a certified electrician, as provided in clause 6th.

(Signed) JOS. HAYNES,
Secretary.

Alderman Sadler: I do not propose to say anything on this question from an electrical point of view. I have no doubt you see sufficient in this report to interest you. Referring back to the time when the Committee was first formed, I think Mr. Dion, of Ottawa, was on that Committee with myself. I think I referred in our report to the fact that in our interviews with the Underwriters they did not seem to see anything especially hazardous in electric wiring. If you place that alongside of their present position you will notice there is quite a change. I would like to say also in connection with the appointment of inspectors in any of those lines, from my own experience in the City Council, there is often a possibility of being inspected to death. We can hardly do anything now without being inspected. While there is a good side to it, there is a bad side, and the individual's rights sometimes are very much interfered with. But perhaps one of the greatest difficulties is that when the city comes to want an inspector there are always a lot of applicants for the position, and it is the long pull and the strong pull that generally gets it, and it is not always the most competent man; in fact, experience shows that it is the incompetent man. When you take a man of that kind who is appointed to inspect, as we have to-day in sanitary matters, a matter on which the mind of the public is very much exercised, and the man is entirely ignorant of the business which he has in hand, and clothe him with a blue coat and brass buttons, and then have him discuss the question with other practical men of great experience, you can readily see it's a hindrance rather than the accomplishment of any good. I think it is from that point largely in connection with electrical companies that the question of inspection should come up; and when it does I would urge that you use your influence as far as possible, if there is going to be a system of inspection, that the most competent man that can be got shall be appointed—a man perfectly independent of any of the existing companies, who cannot be bought in any shape or form, that will do right, and it will be very much in the interests of the electrical companies as well as the public at large. (Applause.)

The President: The report of this Committee is before you for discussion. It is hardly necessary for me to call the attention of the Association to the seriousness of having such alarming documents going forth from public institutions as those read by the Committee. I have no hesitancy in placing myself on record as saying that while there may be some foundation for some of the alarm expressed, the true spirit of that report from the Board of Fire Underwriters is for the purpose of relieving them from incurring such expense as they would be put to in connection with the establishment of a bureau of inspection. The report comes from my own city, and it may be more or less of a reflection on those of us who are in that city because we have been unable to bring the Board of Fire Underwriters around to view it from the point that it is viewed from generally throughout the United Stat-s and parts of this country. As stated by Mr. Sadler, when three years ago we interviewed the board of Fire Underwriters in Montreal with a view to having them establish a bureau of inspection, one of the managers of one of the principal companies in this country and England stated to me before the Board of Fire Underwriters that their statistics did not show a sufficient loss from fires directly attributable to electric causes to warrant their going to any expense to establish a bureau of inspection. He said, "your companies are responsible, you can form your own inspection." Since that time there have been some serious fires throughout the country, which by some are attributed to defective electric wiring. There is another serious matter that has come up in this connection; some of the insurance companies of Montreal, have taken an action for damages where there has been the slightest indication of a fire having been caused by defective wiring; and there have been brought some very heavy suits against some of the Montreal electric companies. There is one now pending for $120,000, and the attitude of the insurance companies at present indicates without doubt that that is the course they propose to pursue. We have got to take such steps as will protect ourselves against such unjust measures. I am speaking now from my knowledge of the conditions existing in Quebec. In Ontario I think it is somewhat better. I am going to ask for the views of some of the Ontario members as to the procedure of the Board of Fire Underwriters in that Province. I will ask Mr. Wright to let us have his views on this matter.

Mr. J. J. Wright: We have not had as much trouble apparently in Toronto from the insurance people as you appear to have had down in this end of the country. The Board of Underwriters in Toronto appoint inspectors who are supposed to look after all wiring installations in the interests of the insurance people. These inspectors, I believe pay themselves, but they tax the companies. We have to pay to the insurance companies a pretty good proportion (speaking now of my own company particularly) of the cost of the inspectors, our company I presume being the largest in the city. Some of the other wiring companies—small concerns—I think subscribe a small amount towards the expense of this inspection, but I believe we pay the major part of it. There seems to be no special tariff or tax; they simply come to us and say "Here, you want to pay some of this; it is through you we are put to this expense!" and rather than have any trouble we simply go down in our pockets and pay it. This inspector appointed by the Board of Underwriters inspects all new installations when wiring is done. The wiring contractors notify the inspector that the work is to be commenced on a certain building and he makes it his business to inspect the work that is in course of construction. He issues his certificates and there is a tacid agreement between ourselves as the operating company, the electricity producing company, not to supply current to any building until the insurance inspector has issued his permit. Should he be out of town or not available at the time, and the service urgently required, the Secretary of the Board of Underwriters usually grants permission to make the connection subject to the inspector's approval at as early a date as possible. That is the method adopted in Toronto, and I believe in most of the towns of Ontario, and we find it works fairly satisfactorily all round.

Mr. A. A. Wright: I would like to ask the gentleman who has just spoken if, when the companies get a certificate from this inspector, that relieves them from any legal damages in case a fire should occur in that building and it was alleged it had taken fire from electricity.

Mr. J. J. Wright: I don't know that it does. Very often in contracts for wiring the architect specifies that the work must be done in accordance with the rules of the Board of Underwriters. I presume it would relieve the companies from any action to be taken by an insurance company. If the insurance companies issue a certificate that they are satisfied with that wiring, I think it would debar them from bringing an action. But in regard to this question of damages we take precious good care to protect ourselves; we will not make a connection to any man's building unless we have a contract signed which contains a clause absolving us from any evil results of putting this current in the building. If a man won't take electricity on those terms he can't have it.

Mr. A. A. Wright: How do you do in the case of the tenant? Do you get an acquiescence from both?

Mr. J. J. Wright: There is a clause in the contract that the wiring used in that building is the property of the customer or consumer. If it is a tenant and the tenant signed the contract asking for light he acknowledges in that contract that all of the wiring is his property and he is responsible for it.

The President: Mr. Wright seems to be in a very happy and strong position where he can say to the customer take it for what it is worth. There are other people who are not in that strong position and you will find where there are three or four competing companies trying to get business in the same town, there will be one or two that are not willing to say that unless the wiring is strictly in accordance with the Fire Underwriters' rules they will not connect with it. I have in mind a very large public institution in one of our larger cities where the wiring was put in by employes of the institution, and it was put in in a most absurdly unsafe manner, a great fire risk and we promptly refused to connect; we were given 24 hours to connect on, or lose the business, and we lost the business, as it was taken on by another company. I have taken the position that the interior wiring of a house should as far as possible be under the entire care of the tenant. I know that is the way it is in England, and I don't see why the supply company should be any more responsible for the condition of the wiring inside a house than the water company is for the plumbing. When you have a valve or joint that leaks you don't run to the water company, you go to the plumber. There has been a great deal of discredit put upon many of the supply companies for the very reason that defective wiring for which they are not responsible is considered more or less under the care of the supply company. It is a pretty serious matter, and I trust it will receive the full consideration of the members here, or rather let us have a full expression of their ideas.

Mr. O. Higman: This cry against the danger of electric lighting should be stopped; it is unfounded and mischevious. I remember reading the statistics of of the city of London, for 1899 I think it was, as to the number of fires that had occurred in the city and the causes from which they arose. I speak now entirely from memory. For kerosene it was 1200 odd; gas 960 odd; and electric lighting 240. That comparison, as some know, was not well founded, but it shows how safe the electric light is as compared with the other systems of lighting, and I think the insurance people are certainly standing in their own way in making this trouble about electric lighting; it is by all odds the safest light that we have. I know that on one or two occasions in Ottawa when the cry of fire caused by electric wiring has been raised that it was entirely without foundation. It seems to me that it is a matter that rests entirely with the insurance people; they are trying to safeguard their interests and it is for them to meet the expense of the inspection. In England, as Mr. Gossler has already said, the interior wiring is under the entire control of the consumer and the supply company is not held responsible either for the condition or anything that might happen to the building caused otherwise.

Mr. J. W. Purcell: In the city of Detroit the city maintains an inspection under the public lighting commission; they charge the consumer for the inspection; or if the contractor who does the wiring makes an arrangement with the consumer to pay for the inspection he charges for the inspection. In the State they have an inspection; they charge the consumers right through. They have a regular price list and they charge according to that, and it is all set down in black and white; you know exactly what you are paying for and what you are getting.

Mr. Fred. Thomson: I think there should be some method of inspecting the contractors for electric wiring. We have in Montreal young men who do wiring who know no more about wiring than about flying. I think there should be some inspection of the contractors and the inspectors; that is where the danger comes in in wiring. I am in the business, and I have seen cases where there have been 56 amperes running on a No. 14 wire, and of course the wire was practically red hot.

Mr. Reesor: I think the way to get over that is for the companies to refuse to connect if wiring of that kind is being done.

The President: All companies won't refuse to connect on and the business is discredited.

Mr. Reesor: My experience in the town of Lindsay has been rather limited as far as the Underwriters are concerned. We have had but one fire that has been directly attributable to electric wiring; it was in a livery stable where there was a leaky roof, and the wiring connected to wooden cleats. When our attention was drawn to it we wired the place properly. But we have had no regular inspection. The inspector comes there periodically from the Underwriters' Association and makes such inspection as he thinks well and suggests any improvements or notes any defects and we fix them; but altogether I don't know that it has been very hard on our company. We had a visit recently from the representative of an individual insurance company; he was sent, so he said, from his company to inspect the risks that his company were carrying. He followed in the wake of the inspector from the Underwriters and in some cases changed what the Underwriters' inspector had passed. It all comes back to us; it makes work for our company, and we get paid for it; we don't object to that at all. But the system they seem to have is not uniform. If the individual company's inspector acts one way and the Underwriters' inspector another it is difficult to know where we are at. As far as liability to accident is concerned outside of fire, we protect ourselves as far as possible by taking out an employers' liability guarantee; but fire accidents have been very limited; with that one exception I think we have had none.

Mr. C. Doutre: In connection with what was said, I understand the contractors of the city of Montreal are forming themselves into an association, and at the next session of the legislature they hope for incorporation of that association; they trust by that means to weed out the incompetents.

The President: Is that an organization or a union?

Mr. Doutre: A union. They hope by that means to weed out incompetents, some of whom hardly know how to use a pair of pliers. In connection with the remarks of Mr. Higman, I think it is hardly fair to make a comparison of the wiring conditions in London and Montreal. I understand the wiring rules in London are very much more rigid than in the city of Montreal. I may say as far as I understand, there is really no inspection of electricity in the city of Montreal. Mr. Plewes' certificates, I understand, are accepted by the fire underwriters, but he is not their inspector; in other words, Montreal is without an electrical inspector properly accredited to the Fire Underwriters' Association or the city of Montreal.

The President: They take the attitude that the supply companies are responsible.

Mr. Doutre: If you consult the Fire Underwriters' Association they will send you to the city; if you go to the city council or the city electricians they will say, "We have no control over Mr. Plewes." Who is Mr. Plewes? He has an office down town and he performs inspection. I think it would be a very good move on the part of the companies operating to have an inspector appointed, and great care should be taken to see that a thoroughly competent man is appointed.

Mr. A. A. Wright: If there is a fire and they allege that it has been caused by the electric current, who do they hold responsible, the man who did the wiring or the man who furnishes current.

Mr. Doutre: I have never heard of any man who did the wiring who was held responsible, for the reason the man has no money to get and the company has.

Mr. O. Higman: The Institute of Electrical Engineers in England prepared the specifications for electric wiring and imposed these specifications on the municipalities; it was given that power by law. No wiring contractor could deviate from the specification prepared by the Institute of Electrical Engineers. Now it remains for this Association in Canada to prepare a specification for wiring and see that it is carried out by act of the local legislature or some other body that can give it the power of law so that you will not be subject to the annoyances that you are.

Mr. Geo. H. Berg (Boston): I do not know that you are aware of how they do things in Boston. Before a contractor can take the wiring in a building or before he is given the right to go ahead, he is obliged to pass a board of examiners at the city hall giving him the right to go ahead and do the wiring. He goes to work and does that work under the Board of Fire Underwriters' laws, which are acceptable to the city of Boston. When that contract is completed no current is allowed to be turned on until the contract has been inspected and the work accepted by the city of Boston; and the inspector there cannot be bought. I have had considerable experience with him. That contractor as a consequence does his work right. (Laughter).

The President: Is that inspector a city or Fire Underwriters' official?

Mr. Berg: He is a city official. He merely goes ahead and does his work under their laws. And then the company can't take and turn the current off. If you have a contract and say, "I won't put the current on until it is accepted," you can't afford to do that, the other company will do it.

The President: Where do the Fire Underwriters come in?

Mr. Berg: They don't come in any more than the city of Boston works under the Fire Underwriters' laws. In that way we do away with and eliminate the irresponsible contractor; that is, as Mr. Thomson says, any man that can swing a No. 14 wire can't go up there and do the work. You do not want to employ a man unless he is capable of doing that work and doing it right. In that way we have no trouble, either in turning the current on or from fires. I am under the impression that the contractors are held responsible for defective wiring. I never heard of the company being held.

Ald. Sadler: I might say in looking up this question I have a communication from Boston, and I find that the city of Boston has what they call a wiring department; there are thirty-one inspectors and a head to the department. I understand the head of the department has a salary of $5,000 a year and the inspectors $1,000 to $1,800. You see at once there is a lot of people to contend with, 31 inspectors, and have them all right.

Mr. Berg: It is very agreeable to do business with them; you know when the work is done that it is right.

Mr. Sadler: Speaking as a consumer, in answer to what Mr. Thomson said about wiring, it brings to my mind a company which I am in where a short time ago the wiring was condemned by an inspector. We had to do some re-wiring and make some alterations. The board asked for tenders for these alterations that had been specified. They received tenders all the way from $25 to $75 or $80. There was a considerable variation between the lowest and highest tender, and while looking up this question of inspection I took upon myself to make some enquiries. I happened to know some of the parties making the higher tenders and I feel confident in stating that they were nearest the mark and were not making a fortune out of the work at $75. But, however, the company took the $25 contract, had the work done, got the certificate and went on with their lighting. Now, there is something wrong there; who suffers or who is going to suffer I don't know, but certainly the consumer ought to have some protection. If there is a standard for wiring it would be an easy matter for the people doing the wiring and the consumer to meet on some level plane.

Mr. Dion: I think we are all agreed that there are things to be remedied; that the relations between the people connected with electric wiring and electric supply, and the consumers and the Underwriters' Association are not what they should be, but the question is, how are you going to remedy it? I am of the opinion that you will never get a proper system of inspection of wiring coming from the Underwriters. I came to that conclusion in the first interview I ever had with the Underwriters' Association in Montreal when I approached them as a member of the Committee of this Association, and I have had no occasion to change my mind since. They will make all the rules you want but they will not spend any money to get them enforced. Whether they have not the money to spend or whether they think the dangers to be avoided are not such as would warrant them in making any expenditure I don't know, but the fact remains that they are not disposed to spend any money for inspections, and I have lost any hope of our ever getting them to move in that matter. You must remedy the trouble either by provincial or municipal law. The city of Montreal may be averse to establishing an electrical bureau but it seems to me you will never remedy the present state of affairs until you have some law formulated either provincial or municipal, which will prevent any company connecting to a consumer's wires until the inspection has been made. I don't believe you could get a provincial act; if you could it would be preferable. If you think you can get a municipal act passed it seems to me you should concentrate your efforts in that direction, together with the obtaining of a proper inspector. No doubt you run the risk of having an unsatisfactory inspector, but I fail to see any other way out of the difficulty. Do not look to the Underwriters; they will not do anything.

Mr. F. Schweatmann, (St. Louis): I hold that one of the very first things required is good rules. As a manufacturer of switches, I have tried for three or four years to get up a line of switches which would be acceptable to the Board of Fire Underwriters all over the United States; I have absolutely failed to make such a line of switches. I find a switch after suiting probably one city would not suit another at all. It is absolutely impossible to have inspectors taken care of until you have taken care of the rules. Some cities are very much more careless in this regard than others, and until there is a general rule adopted, not only by the Underwriters but by the producers of electrical energy, to instruct your inspectors the same in San Francisco or New York, or in Toronto and Quebec, you will not succeed in getting any inspection that is satisfactory.

A Member: Do you consider the rules of the National Board of Fire Underwriters are comprehensive enough to cover the case?

Mr. Schweatmann: Fully so if lived up to. Unfortunately I hold that there is 98 per cent. of all apparatus, switches and materials for wiring, that is made in the United States which does not come up to those rules and sell it you can't, because there is a lot of apparatus that is sold below that and accepted. I have sent a line of switches for three years to their Inspection Bureau and each time they had some suggestion to make, and each time I went into it to see if they would finally set a switch which they would guarantee to pass anywhere in the United States and they simply would not do it. After we had complied with all the rules of the Fire Underwriters, they still had some suggestion to make, and then they said that particular piece of apparatus might be good for several months but then they might add to their regulations and therefore it might be changed. We have a City Department and in this department we have inspectors, but they don't attempt for one moment to take care of the inspection. It is a very excellent institution, but it is only due to the quality of the local man, the inspector of the Board of Fire Underwriters. I daresay he will not pass anything but good work. The companies are trying to help him all they can and they will not connect without a certificate from him; and while they do not help in a financial way they would gladly do so if there was a way of doing it. The customer pays for the inspection.

Mr. Holman: I want to say that my thought on the subject is, that we are in the process of evolution; we are young at the business. I am personally acquainted with the particular rule Mr. Schweatmann has referred to, and that is that it requires 50 amperes per square inch of contact surface. We know that that is very large in the small switch and small in the large switch. This is true for certain small switches of 25 ampere capacity; for switches of a larger capacity the reverse is true. It is simply a question of the business not having been evolved far enough. Then further, regarding inspections in New York City where there is an inspection by the city and another by the Underwriters and neither certificate alone is sufficient, I have had personal experience with that, and it is necessary to get both certificates. And the City is perhaps the most difficult one to get. In Philadelphia there is no City inspection or was not up to a few days ago at least. We took the certificate of the Philadelphia Fire Underwriters, which institution was conducted by the associated assurance companies. They had a graded system for charging and $2 was the lowest charge. The consumer and the wiring contractor generally took care of that. The electricity supply system did not pretend to take care of it. It is contended that the fault, if there is any, is the fault of the house owner and not of the energy producing company.

The President: I beg to differ with you; I don't agree with you that we are young in the business.

Mr. Holman: I know that the General Electric Company was up against it and is up against it still with the other manufacturing companies, that a switch which is adequate for a certain capacity—where another capacity is required, the 50 amperes to the square inch, which complies with the rule, is not really sufficient.

The President: The rule may be insufficient, but I question about the experience being insufficient. If the rules have not been specific enough to cover all cases the rules have not been properly framed.

Mr. Holman: Perhaps it is a question of electrical politics, because certainly the men at the head of the National Underwriters' Association who endorsed the rules of that Association and those who have conferred with them as representing the supply companies are pretty acceptable men and I think the difficulty is that there are certain differences and they have not got down to business.

Mr. Schweatmann: That is only one of the difficulties we have run against; there have been twenty-five more. I believe the National Board of Fire Underwriters are all right but some modifications should be made and some additions made. But it is not so much that,as the fact that they will not enforce the rules; and even if you make up apparatus conforming with their rules they will not guarantee that the apparatus will be accepted anywhere in the United States; and if a cheaper apparatus is accepted there is no inducement for a manufacturer to try and make an apparatus that will conform. The object is to make money by competing in the sale of apparatus; and if you attempt to compete with high priced good apparatus as against low grade apparatus and both are equally acceptable it is not much inducement to you. I hold that electrical manufacturers and producers of electrical current should get together and make rules which are acceptable to the Board of Fire Underwriters. Until you do, you have but very little hope of ever getting satisfactory inspectors.

The President: There have been no definite conclusions arrived at which will permit of our taking any definite steps. I submit that when the proper time comes this Committee on Fire Underwriters' rules should be continued and we will have to continue from year to year until such time as rules are evolved in accordance with our experience.

Mr. Yule moved that the report be received and adopted, the Committee continued, and a vote of thanks tendered to Alderman Sadler for his very able report.

Mr. Higman: I would second that, and in doing so would throw out a suggestion for the use of the Committee if they care to adopt it, and that is that we should work along definite lines by getting a provincial act. It is of no use leaving the matter to municipalities, because you will have a different condition of things in each municipality. What you want is a provincial law under which any municipality may pass a by-law and so put the act into operation. In that way it will have the countenance of law and you will be able to force upon wiring contractors right conditions.

Mr. Yule: You will never get a provincial law. The moment you introduce it they put you down as a grinding monopoly. You go to a legislature where they bring in an act or proposal to make the practice of medicine free to everybody, and you can't get a provincial legislature to pass any such law.

The President put the motion proposed by Mr. Yule and seconded by Mr. Higman, which, on a vote having been taken, was declared carried.

The Secretary read an invitation from the directors of the Canadian Electric Light Company to pay a visit of inspection to its power house at Chaudiere Falls and its sub-stations.

At the request of the President, Mr. A. A. Wright, of Renfrew, opened the discussion on the Report of the Committee on Legislation.

Mr. A. A. Wright : I didn't expect that I was to be called upon to say anything on this question ; I did not hear all of the report ; but you know we are told we should be always willing and ready to give a reason for the faith that is within us and being a good Christian I shall endeavor to do so. I may say that the report conveys to the members of this Association a very large amount of information, but I would also like to state, this Committee has done most valuable service for the upbuilding and carrying on of electric lighting in the Province of Ontario. I believe many institutions in the Province of Ontario have been saved practically their entire capital that they have invested, by the passage of that Act which was carried through successfully. It seems to me if every province in the Dominion would undertake to do the same thing it would be a good thing for them. I understand the province of Manitoba has carried through some legislation ; I am also told one of the States in the Union has carried on similar legislation. The men who have had the looking after of this legislation in the province of Ontario have done most yeoman service to every man engaged in electrical work in the province of Ontario, and I am proud to say that nearly every one who is interested in that has responded fairly well in giving sufficiently to carry this work on. We do not want to let this thing lag ; we want to have a sufficient amount of funds in hand for this committee so that whenever any adverse legislation comes up we can meet it at once. We know how it has served us in times past, and we know they are on the watch for us every day seeing where they can catch us napping. We have been very careful in the past and we have had good and sufficient men to look after this thing. All I can say is I hope that they will continue on in the way they have been doing and we shall try and assist them with our money. (Applause.)

Mr. Higman: There is just one mistake Mr. Wright has made,and that is in supposing that the legislation committee has met with very general support from the electric lighting companies. That has not been the experience of the Executive Committee. While quite a number have responded liberally to the invitation to support the work of the committee, there are a large number who have not done so. Now, it is very clear that all are reaping a benefit from the legislation that has been had, and from the work the committee is doing, and it seems to me there should be a more general response in a financial way to the needs of the committee. It is the smaller companies really that are reaping the benefit of the legislation that has been procured and I think it rests with them all to do something in the way of financial assistance. There is also the question of educating the people outside to the fairness of the position of the electric lighting companies. The press of the country is lamentably ignorant, it seems to me, as to the true position of affairs. The legislation that has been secured in Ontario has been taken from the English Act which applies to gas, water and electric companies in that country and sanctioned by the Board of Trade as a perfectly fair and reasonable proposition, namely, that those who have invested capital in concerns of this kind should receive a fair amount of protection and consideration. I maintain that the equity and fairness of the Conmee Act is beyond controversy. There should be no question as to the reasonableness of the position of the electric lighting companies to be remunerated or considered properly when the municipality wishes to step in and do the business that has been created by private investments.

Mr. Dion moved, seconded by Mr. A. A. Wright, that the report of the Committee on Legislation be received and adopted, and that the thanks of the Association be tendered to the members of the Committee, and that the Committee be continued.

The President, in putting the motion, said: The organization has been very fortunate in having its interests very well looked after in the past, and if its interests are looked after as well in the future as they have been in the past no fear need be entertained.

On a vote having been taken the motion was declared carried.

The President : I will call for the report of the Standardization of Accounts Committee, and I will ask Mr. A. A. Wright, of Renfrew, to present this report.

Mr. A. A. Wright: I am certainly very sorry that the chairman of this Committee is not present to read the report; also I am very sorry that the other member of the Committee is not here to read it to you, and that it falls upon the weaker and the innocent and aged member of this Committee to read it.

REPORT OF THE COMMITTEE ON UNIFORM ACCOUNTING.

To the Canadian Electrical Association :

GENTLEMEN,—Your Committee on the Standardization of Accounts for Electric Light Companies in submitting its report for your consideration regrets that its individual members being men very busy in their respective occupations may not have been able to devote in research the time necessary to do full justice to the duties that the Association has placed upon them.

As a preliminary to the work, your committee collected an array of blank forms the examination of which shows that these blanks and the treatment of expense accounts differ widely as between the different companies, and while possibly, generally speaking, the various companies charge the same factors to cost of production prior to paying dividends, it is a difficult matter to ascertain whether or not they do, and a lack of uniformity in accounting is here very much felt, almost every company having a different way of arriving at the Revenue and Expenditure.

In the examination of these blank forms your committee feels impressed that the prime object to be sought is not so much to go fully into the matter of books and forms, but to decide upon a classification of accounts under uniform headings and groups, affording an intelligent and simple means of comparison between companies and ensuring true statements of the cost of products.

With this prime object in view, your committee set to work, but before proceeding far, found that our sister Association in the United States had already taken up this work and that a similar Committee of the National Electric Light Association had already reported upon a Standard System of Accounts for Electric Lighting Companies. The system of accounting as set forth in such report was adopted by the National Electric Light Association at its convention at Niagara Falls in May, 1901, and by the adoption, as the president clearly set forth, it was meant that the system was to be put into effect by the members of that Association at as early a day as practicable. It is evident that the American Committee with funds at its disposal for expert research has gone into the matter in a thorough and business-like manner, and the system as submitted seems to cover the ground admirably, impressing your committee very strongly that it would be of material benefit to lighting companies in Canada, with our limited field, had we a system uniform with that of the wider field across the border. It was also found that one large Canadian company has been using with satisfactory results, a system of accounting very similar to the one now in question.

Your Committee therefore after careful consideration recommends the adoption of the Standard System of Accounts for Electric Lighting Companies as adopted by the National Electric Light Association in 1901. A copy of this report is appended hereto, and the Committee further respectfully suggests that copies of this report be obtained from the National Electric Light Association, or that same be re-printed with the permission of that Association and mailed to all members of our own Association, and that the adoption of this report if it is adopted, shall mean that it be put into effect at as early a day as possible whether it be this fiscal year or the next. In recommending the adoption of this report of the American Committee, it might not be amiss to quote the words of the President of the National Association when referring to that Committee and in which he says: "The Committee is composed of men that have been a lifetime in this business and I know of no men that stand higher in the field than they do, and I feel that it is perfectly safe for the Association to adopt this report."

Your Committee recognizes the fact that the Association cannot compel its individual members to adopt this uniform system, but its adoption can be strongly recommended and every manager of an electric light company must feel that it would be to his advantage, to benefit by the experience of some of the cleverest men in the business in the United States, as such men are who formulated the system now submitted.

Your Committee feels that it might not be amiss to here set forth in as few words as possible some of the reasons advanced showing the necessity for a uniform system of accounting. About two years ago a paper was presented at a Convention of our Association setting forth a system of accounting, and in the discussion that followed, a resolution was introduced whereby a Committee was authorized to form a Standard System of Accounts for Electric Light Companies that could be adopted by this Association, so that we might come together and compare costs, and if one central station manager was able to generate electricity at a less cost than another, it would be to the advantage of all to know just where the saving in cost of production is being made.

Furthermore, if the cost of production of the different companies was accurately known, and if managers of new and competing companies were able to obtain this information, it would without question sometimes prevent ruinous competition. Occasionally opposition companies start up, employing a practical electrician who possibly understands little of the financial part of the business, the Directors and their accountants themselves knowing nothing of the cost per kilowatt hour output, quote rates much lower than the old company, thinking as a newer concern with modern machinery and possibly a smaller capital invested, they should afford to sell cheaper; therefore, it is reasonable to suppose were they able to obtain from some central source, accurate reliable information, ruinous rates would be seldom quoted.

Then again, the feeling in favor of Municipal Ownership is growing very fast, consequently it is important for companies to be in a position to show municipalities and the public generally, that they are deceiving themselves in regard to the cost of manufacture and the large profits of the companies.

It does not mean if we keep our books according to this uniform system that a statement of our revenue or of the cost of our apparatus, or of the cost of producing current, need be given to the Public, to this Association, or to anyone, but the idea presents itself very forcibly to your Committee, that it would be an excellent plan if reports could be sent annually to the Secretary of our Association from all electric light companies, and that a summary of such in tabulated form should be available for members of the Association. It would not be necessary to give amounts and thus give away our business in any manner ; such reports could be solely on a percentage basis and upon a form common to all, for instance—

Cost of Manufacture (Generating)
(State what percentage it bears to the Gross Revenue)
Operating.

1. Power Plant Wages (What percentage of total cost of generating)
2. Fuel for Power (What percentage of total cost of generating)
3. Water Power (What percentage of total cost of generating)

Etc. Etc.

Maintenance.

8. Maintenance of Boilers (What percentage of total cost of generating)
9. Maintenance of Engines (What percentage of total cost of generating)

Etc. Etc.

and in a similar manner for the different branches of expenditure. each division of expenditure showing what percentage it bears to the Gross Revenue ; and each sub-division what per centage it bears to the total cost of that particular division of expenditure.

In this way it will be possible to determine where economies should be made in order to bring the cost down to a minimum, while giving a maximum efficiency of service to our customers.

Respectfully submitted,
D. R. STREET, Chairman
A. A. WRIGHT.

QUEBEC, June 11th, 1902.

Mr. A. A. Wright : We attach hereto a very interesting book which gives a valuable amount of information. I myself and the other members of the Committee have thought that it would be hardly possible for us to obtain and secure a better system than is laid down in this pamphlet, so clear and so concise, and it must be apparent to everybody that it is thoroughly efficient in its work.

The President: You have the report before you of the Committee on Standardization of Accounts. I think the organization owes a very great debt to this Committee for this report. The report is now open for discussion.

Mr. Dion: This is a very thorough report, and it offers suggestions of great importance to central station managers, and there are not very many in the room at the present moment. The report requires careful consideration; I would not like to see it thrown out or passed without further consideration or discussion or without some action being taken to carry out the suggestions contained in it. I would therefore suggest that the discussion upon it be postponed; we may have another opportunity of discussing it. I think Mr. Wright will agree with me it would be better to have a larger representation of the managers and the members responsible for the operation of central stations when this comes up. If this meets with the views of the members present now I think it would serve the interests of the subject better.

The President : I think that is a very good suggestion.

Mr. Holman : I beg to suggest that the system of accounting be made to include railway systems. As I understand it this Association is one of allied interests, and I think that an accounting system for railways should be incorporated in the report. The National Electric Light Association deals with the generating station.

The President :While this does not contain anything in regard to car service, the system, by modification, could be very easily applied to railway systems. It is very difficult to establish a standard system of accounting to apply to all localities, the same as with the subject we were talking about a little while ago. For myself I think the system as proposed in the report to the National Electric Light Association, a copy of which report is here attached, can be very much simplified without sacrificing any good results. The report as put before the National Electric Association contained practically the system adopted by our ex-President, Mr. W. H. Browne. If Mr. Dion's suggestion meets with your approval I will proceed.

Mr. Dion: Before finally disposing of this matter I would like to say in answer to Mr. Holman that I understand from one of the members of the Committee on Accounting that the reason they did not consider the accounting of railway companies was that he understood that the railway companies of Canada had already adopted the American system or the system recommended by the American Street Railway Association, and that being the case there was no further regulation required in their case, and the Committee confined its report to electric lighting.

The President: Does the suggestion of Mr. Dion meet with the approval of the Association, that the discussion be postponed till we have a larger representation? (Voices: Yes.)

The President: If that is so I would suggest on the same lines that the Report of the Committee on Data be also postponed. I will now appoint Messrs. J. J. Wright and K. B. Thornton as a Committee to strike the Standing Committees for the year.

Mr. Dion: You remember that two years ago a Committee was appointed to revise the Constitution. This Committee did not make a report last year because it was not then in a position to do so, but some amendments to the Constitution were proposed and carried. The Committee has since continued its work, which has consisted in re-arranging and changing some of the wording of the Constitution rather than making any radical changes. The old Constitution can be amended in accordance with Article 10 in a certain manner, and it is necessary that a notice be given at this session of the Convention or at least that permission be granted at this meeting for the introduction of a notice of motion and that this motion be made at the next sitting, and that discussion on the amendments take place upon the following day. In order to carry this out it is necessary that this permission be asked for and granted now; that would allow the main question to be discussed some time to-morrow. We report as follows:

QUEBEC, June, 1902.

To the Members of the Canadian Electrical Association:

GENTLEMEN, — Your Committee appointed at the General meeting of 1900 to revise the Constitution beg to report that they have carefully examined the Constitution, and amended it in the light of the experience which has been gained in the many Conventions of this Association held since the old Constitution was adopted:

The amendments carried last year as to membership and fees have been drafted in. The changes consist mainly in covering points which the old Constitution did not provide for. We have made no radical changes, but rather a general re-arrangement of the articles and wording thereof for better form, and greater completeness and freedom from ambiguity. We do not wish to criticize the old Constitution which has done service, but the Association in its rapid growth had got beyond its scope.

Rather than recite at length the alterations proposed it will save time to proceed (under Art. X of the present Constitution) in the following manner, viz:

"We ask permission to introduce the following notice of amendment.

We the undersigned hereby give notice as provided by Art. X of the Constitution that we desire to amend said Constitution by substituting therefor the following amended Constitution in which reference is made to each Article which is changed thereby.

PROPOSED CONSTITUTION OF THE CANADIAN ELECTRICAL ASSOCIATION, 1902.

ART. I.—NAME (unchanged). This organization shall be known as "The Canadian Electrical Association."

ART. II.—HEADQUARTERS (old Art. XXVIII unchanged). The permanent office of the Association shall be in Toronto.

ART. III.—OBJECTS (old Art. II amended). The objects of the Association shall be:

(a) To advance the knowledge of the members in the various branches of applied electricity by holding meetings for the reading and discussion of papers and general interchange of opinion.

(b) To promote the professional and commercial interests of those engaged in any electrical work or enterprise.

(c) To foster friendly intercourse between the members.

ART. IV.—MEMBERSHIP (old Art. III and V amended).

(a) The Association shall consist of honorary, active, associate, and junior members.

(b) Active members shall be all those actively engaged in electrical enterprises (other than the manufacture or sale of electrical apparatus or supplies) electrical engineers and those engaged in matters of electrical education.

(c) Associate members shall be all others applying whom the executive committee consider eligible to become members of the Association.

(d) Junior membership shall be confined to students in electrical engineering.

(e) Associate and junior members shall be entitled to attend all meetings of the Association except those of the Executive, and take part in all discussions, but shall not be entitled to vote for the election of officers or be eligible for office.

(f) No person shall remain a junior member for more than two years, after which he may apply for active or associate membership.

(g) Honorary members shall be elected at any session of a general meeting by a two-third vote of the active members present.

ART. V.—FEES (old Art. V and XXVII amended):

(a) The annual fee for active and associate members shall be $3.00. The Executive Committee however are authorized to increase the fee to a sum not exceeding $5.00 at any time they may deem it expedient in the interests of the Association.

(b) The fee for junior members shall be $1.00 per year.

(c) All fees are payable in advance and members in arrears for six months or more shall not enjoy the privileges of membership.

ART. VI.—OFFICERS. (Old Art. IV amended). The officers shall be a President, a first Vice-President, a second Vice-President, a Secretary and a Treasurer.

The President and Vice-Presidents shall be ex-officio members of the Executive Committee. The President shall be ex-officio a member of all other committees of the Association. The offices of Secretary and Treasurer may be held by one person.

ART. VII.—EXECUTIVE COMMITTEE. (Part of Old Art. IV amended). The Executive Committee shall be composed of ten active members, five of whom shall remain in office for two consecutive terms.

ART. VIII.—DUTIES OF THE PRESIDENT. (Old Art. XXII amended.) The President shall preside at all meetings of the Association, call meetings of the Executive Committee on the request or with the consent of three members of said committee and when directed by the said Committee call special meetings of the Association.

ART. IX. DUTIES OF VICE-PRESIDENTS. (Old Art. XXIII amended). The first Vice-President, or in his absence the second Vice-President, shall in the absence of the President perform his duties.

ART. X.—DUTIES OF THE SECRETARY. (Old Art. XXIV amended). The Secretary shall attend all meetings of the Association, keep a record of proceedings thereat, notify members of their election and of all meetings, and perform such other duties as the President or the Executive Committee shall direct. He shall report at every Annual General Meeting on the state of the membership of the Association.

ART. XI.—DUTIES OF THE TREASURER. (old Art. XXV amended.) The Treasurer shall keep correct accounts of all cash receipts and disbursements, Assets and Liabilities of the Association, deposit the funds of the Association in a chartered bank approved by the Executive Committee, make all payments authorized by the Executive Committee, and no others, by cheques countersigned by the President. He shall submit at every Annual General Meeting a financial statement for the year ended the 31st. May preceding said meeting.

ART. XII.—DUTIES OF THE EXECUTIVE COMMITTEE. (old Art. XXVI amended.) The Executive Committee shall be the governing body of the Association, shall manage the funds of the Association which however may not be used for purposes of entertainment, pass upon all applications for membership and the eligibility of applicants subject to the Constitution and such other rules and by-laws which may be adopted by the Association from time to time.

ART. XIII.—MEETINGS. (new article.) The association shall hold a general meeting annually at a place to be selected as provided by Article XIV, and at such time as the Executive Committee for a term immediately preceding such general meeting shall decide, not earlier than 1st June. Special general meetings and meetings of the Executive Committee may be held as provided by Art. VIII.

ART. XV.—QUORUM. (old Art. XX amended.) Ten active members shall be a quorum for business at general meeting, and four members of the Executive Committee shall be a quorum for business at meetings of said Committee.

ART. XVI.—ELECTION OF MEMBERS. (new Article.) Active and associate members shall be elected by the Executive Committee upon written application signed by the applicants and countersigned by two active members.

ART. XVII. ELECTION OF OFFICERS AND EXECUTIVE COMMITTEE. (old Art. VI and VII amended.)

(a) The officers and members of the Executive Committee shall be elected by ballot at every Annual General Meeting, to hold office from close of said meeting until the close of the general meeting at which their successors shall be elected, except the five members of the Executive Committee who shall hold office for two such terms as provided by Art. VII.

(b) The election shall take place in the following order: 1. The President. 2. The First Vice-President. 3. The Second Vice-President. 4. The Secretary. 5. The Treasurer. 6. The five members of the Executive Committee who shall serve a further term. 7. The other five members of the Executive Committee who may be any active members, including the retiring members of the Committee.

(c) The precedure shall be as follows:—

1. The Chairman sball appoint two active members to act as tellers, whose duty it shall be to collect the ballots, count the votes and report the results to the Chairman. A nominee for any office cannot act as teller for the election to that office.

2. The Chairman shall call for nominations for the first office on the list in preceding section (b) and allow three minutes for making nominations, after which he shall declare nominations closed, and no nominations shall be received thereafter. Any active member present may nominate any other active member for any office.

3. Every active member present shall deposit with the tellers a paper ballot bearing the name of the nominee for whom he desires to vote, and nothing else.

4. The tellers having reported the result of the vote, the Chairman shall declare elected the nominee receiving the greatest number of votes, unless such number be less than a majority of the votes cast. If no nominee receives a majority of the votes cast, the nominee receiving the least number of votes shall be retired from the contest and a new ballot shall be taken, repeating if necessary until a nominee shall have received a majority of the votes. This sub-section shall not apply to the election of the Executive Committee.

5. If only one nomination is received for any office the secretary shall deposit with the tellers a ballot which shall be deemed to represent the votes of all active members present, and the Chairman shall declare the nominee elected.

6. The procedure set forth in sub-sections 2, 3 and 4 of this section shall be repeated for the different offiees.

7. In electing the Executive Committee a ballot will first be taken for the five members who are to serve a further term. The result of this ballot having been announced a second ballot will be taken for the other five members required to serve on the committee. In both ballots five names must be written on each ballot paper, and the five members receiving the greatest number of votes shall be declared elected.

(b) At the request of five active members made immediately after the result of any election has been announced, a recount of the votes shall be made.

(e) At the close of the sitting at which the elections shall be held, the President shall destroy the ballots.

Art. XVIII.—Vacancies in Office. (Old Art. IX amended.) Vacancies in office from any cause shall be filled by the Executive Committee for the remainder of the current term.

Art. XIX.—Committees. (Old Art. XVIII and XIX amended).

(a) At every annual general meeting the members shall decide by resolutions what special committees, if any, shall be elected for the ensuing term.

(b) The chairman shall then appoint a committee of five active members to strike such committees.

(c) The report of such striking committee, which shall be submitted to the general meeting at the sitting following their appointment, may be adopted or sent back to the Striking Committee for reconsideration, but shall not be amended except with the unanimous consent of the striking committee, provided always that if any member named in said report refuse to act, the vacancy shall be filled immediately by motion.

(d) The adoption by the general meeting of the report of the Striking Committee will constitute the election of the special committes named thereon and all such committees shall serve from the close of the meeting at which they shall be elected until the close of the next following general meeting.

(e) The first named of any special committee shall be the convenor thereof. At their first meeting every committee shall elect a chairman for the current term, who shall thereafter be the convenor.

(f) All special committees shall make a report at the annual general meeting following their election.

Art. XX.—Auditors (new). At every Annual General meeting the Chairman shall appoint two auditors whose duty it shall be to audit the accounts of the Treasurer and present a written report to the Association during the said meeting.

Art. XXI.—Order of Business. The following shall be the order of business at all Annual meetings. Time for general business, reading of papers and discussions shall be allowed between or after the following orders as arranged by the Executive Committee, said orders shall not be otherwise altered except by unanimous consent of active members present.

1. Reading and approval of the minutes of the last annual and intervening special general meetings.
2. Report of Secretary and Treasurer in consideration thereof.
3. Appointment of auditors in accordance with Art. XX.
4. Reports of Special Committees and consideration thereor.
5. General Communications.
6. Naming of Committees for succeeding term in accordance with Art. XIX section (a).
7. Appointment of Striking Committee in accordance with Art. XIX section (a).
8. Selection of place for next annual meeting.
9. Election of officers and Executive Committee.

Art. XXII.—Rules of Order. (Old Articles XV, XVI, XII, XIII, XIV and XVII amended, Art. XI cancelled.)

(a) Voting. 1. Every active member present at a meeting must vote, but any member who shall enter the room after the question has been put by the chairman need not vote. The chairman shall not vote except in case of a tie when he shall have the casting vote. Voting by proxy shall not be allowed.

2. Except where voting shall be by ballot the chairman will take the sense of the meeting by voice or by asking members to stand, but on call of three active members the Secretary shall record the yeas and nays.

(b) All motions must be duly proposed and seconded, and shall, except those of a purely routine character, be made in writing.

(c) No member shall speak under any order of business more than once or at greater length than five minutes on any question until all other members present shall have had an opportunity to do so, nor more than twice on any one question without the permission of the chairman. The mover of a motion shall have the additional right to reply.

(d) Any motion may be re-considered immediately after its adoption upon a motion to re-consider carried by three-quarters of the active members present. The motion to re-consider may not be discussed. The result of such re-consideration shall be final.

(e) The chairman shall decide all points of order. An appeal may be taken without debate against the ruling of the chair, a vote of two-thirds of the active members present being required to reverse the ruling.

(f) Todd's Parliamentary Practice shall be the governing law of the Association in all cases not provided for in its own Constitution or By-Laws.

Art. XXIII.—Amendments (old Art. X amended). Amendments to this Constitution may be made at any general meeting of the Association in the following manner:

1. Notice of proposed amendment in writing after having been submitted to the meeting shall be referred to a committee of five members appointed by the chairman.

2. Said committee shall report to the general meeting at some subsequent sitting thereof, said amendment in its original form, or with such alterations in the form as said committee shall deem advisable to make without altering the sense or purport of the amendment.

3. A two-thirds vote of the active members present shall then be required to carry such amendment.

A. A. Dion.
J. J. Wright.
John Yule.

Mr. Dion: It requires the consent of two-thirds of the members present to allow this to go through, which does not commit anyone in any manner as to the amendments to be made.

The President: You have heard the notice of motion and in accordance with the Constitution a majority of two-thirds of the active members present must vote to give the necessary permission. I will ask those in favor of granting this permission to raise their right hand in order that I may count them.

On a vote having been taken the President declared the permission unanimously granted.

The hour of 12.20 o'clock p. m., having arrived, on motion of J. W. Purcell the Convention adjourned.

AFTERNOON SESSION.

At 2.15 p.m., special cars left the Chateau Frontenac, which conveyed the members and their friends to the car sheds of the Quebec Railway, Light and Power Company, where a paper was presented by Mr. A. B. Lambe, of Toronto, on "The Electrical Equipment of an Ordinary Street Car."

The President: The second session of the Association will now come to order and I will ask Mr. Lambe to present his paper. (See page 131.)

Mr. Evans: Mr. President, I take very great pleasure in moving a vote of thanks to Mr. Lambe for his valuable paper which he has just presented to us. I would like to direct the attention of the members to something which to us at least is a novelty. During the first two years we had some trouble with water getting into our cases. In the spring of the year we have to run through water up to our axles and the result was our cases got partially filled with water, although they are supposed to be water-tight, and it caused a good deal of trouble to our fields. We have bored a hole in the bottom of each case and since then we have had no trouble whatever. It is a suggestion which may be useful to other railroads.

The President: I am sure there are quite a number who will only be too glad to second Mr. Evans' motion.

Mr. F. H. Leonard: I second the motion, and in doing so I should like to express my appreciation which I have of the clearness and conciseness of the explanation Mr. Lambe has given us. I take a great deal of interest in the description myself, and I believe that others have solved a good deal that they did not know before about electric car motors from hearing this dissertation.

The President: I am sure there will be no dissension from that vote of thanks so I will say to Mr. Lambe, the Convention gives you a vote of thanks for your valuable paper.

Mr. Lambe: I thank you.

The President: I am sure we all feel very much indebted to Mr. Lambe for his clear and interesting paper on an interesting subject. We are very fortunate in having on our programme another paper dealing with electric railways, so that at this convention the electric railway subject should be thoroughly exhausted as far as it can be in such a limited time. I will now declare Mr. Lambe's paper open for discussion, and I will ask Mr. Holman to make some remarks on the paper.

Mr. Holman: It is very hard; the President has put Mr. Holman in a very peculiar position. I feel something like the small boy who, when another small boy saw him eating an apple and asked him to give him a piece of the core, said, "There ain't goin' to be no core.". I feel somewhat that way about discussing Mr. Lambe's paper, it has been so concise and complete. Although not having been in the railway field actively for the last six years, previous to that time I was very much in it. The paper has been most admirably arranged and has been very clearly presented,ask Mr. Leonard has stated, and in trying to open a discussion on a subject which has been presented in such a general fashion, it is impossible to do so. One might ask for Mr. Lambe's views of how motors, according to his idea, should be rated; that is whether a 25 or 50 h.p. railway motor should be placed at 25 or 50 h. p. as the h. p. developed on the axle, under a certain temperature, or in some other way; in other words, there is a difference in the method of ratings, unlike the ordinary motor or generator. The discussion of details such as rating motors might take up another afternoon in addition to the time devoted to this discussion this afternoon. Personally I know of no questions to ask; I leave it to others. I personally desire to thank Mr. Lambe for his paper. (Applause.)

The President: Mr. Lambe has expressed his willingness to answer any questions you may wish to ask. I know the paper has been very complete and if there is no further discussion desired on this paper I will say that a motion for adjournment of the afternoon session is now in order.

On motion of Mr. Reesor, seconded by Mr. Leonard, the afternoon session was adjourned.

EVENING SESSION.

At 8.30 p. m., the President in the chair, called the Convention to order.

The President : We will open this evening's session by a paper by Mr. W. D'A. Ryan, of Lynn, Massachusetts, the subject of which will be "The Development of Arc Lighting Apparatus from 1801 to 1902, with Special Reference to Modern Arc Light Engineering." I have much pleasure in introducing Mr. Ryan to the Association.

Mr. Ryan read his paper.

The President : You have heard this very interesting and excellent paper of Mr. Ryan's ; I will now lay the paper before you for discussion or remarks.

Mr. Thomas : May I ask Mr. Ryan a question on theory. Will you explain what is the physical nature of the transfer of the current from carbon to carbon ; and also why it is, if I remember correctly, that when an arc is drawn between the carbons the current seems to be suppressed one way or the other ?

Mr. Ryan : I really have not looked into that very carefully. We could talk practically all night on that.

Mr. J. J. Wright : I was just about to suggest, Mr. President, that as the time is getting rather late, perhaps it might be as well to postpone a discussion on this paper to a future session of the convention if there be an opportunity. At any rate in view of the fact that Mr. Ryan has taken evidently very great pains to prepare his paper and get the apparatus here and place it in working order, I would like to move that the thanks of the Association be tendered to Mr. Ryan for the excellent lecture he has just given us and for the immense amount of trouble I am sure he must have gone to in preparing to give us this interesting treat. (Applause.)

The President : Mr. Wright has moved a vote of thanks and I am sure you are all anxious to second it. I know that there will be no dissenting voices and I will declare that motion carried. I may say that there are some of the members of the Association who could enlighten us on the history of the development of arc lamps and arc machines. We have with us Mr. Wright who has just spoken,and who has I think been associated with the early development of the arc lamp possibly more than any other man that I know of, and if it were not so late I would ask Mr. Wright to enlighten us on his experiences, which would be very interesting I am sure ; also Mr. Fred. Thomson, in connection with the development of the arc machine. As it is quite late and especially as a great many of the members spent last night on the boats and trains, if it meets with your approval we will carry out Mr. Wright's suggestion to postpone further discussion on this paper and call it a close for to-night. There has been quite a number of the members making enquiry with regard to the system of decorative lighting in and around the tel, and there has been no general explanation of the system in use, and if Mr. Spaulding is here I will ask him to say a few words giving a general outline as to the rapidity with which this illumination can be used.

Mr. Spaulding, at the request of the President, at this stage explained the system of decorative lighting called the "Elblight," to which the members listened with a great deal of interest.

The President : I am sure the members of the Association are very much obliged to Mr. Spaulding and if there are no further questions a motion for adjournment is in order.

On motion of Mr. Leonard, seconded by Mr. Slade, the session was adjourned.

SECOND DAY.

At 10.15 o'clock a.m. the President took the chair and called the Convention to order. After the reading of communications the President said : We have with us this morning Mr. C. M. Green, who will present a paper on "Arc Lighting." I have the pleasure of presenting Mr. Green to the Association.

Mr. Greene : Mr. President and members : It gives me great pleasure to appear before you this morning. I would like to say that Mr. Gossler, your president, is a man whom I have known for a great many years, and he most assuredly improves on acquaintance ; and he certainly knows how to handle things. I will now read you a paper on "Arc Lighting." (See page 136).

The President : Gentlemen, you have heard this most interesting and valuable paper by our very distinguished member and inventor, Mr. Greene. There are a great many here who are competent to speak of the development and operation of arc lamp systems of all forms, and I solicit for this paper a thorough and full discussion. The paper is now before you for discussion, and as there has been some reference to lighting in Toronto, I will ask our friend Mr. Wright to make some preliminary remarks on this paper.

Mr. J. J. Wright : Mr. President, I rather like this reference to arc lighting in Toronto. I was not aware that that was in the paper, not having had an opportunity of reading it before. Of course, in this world there are very many things we would like to have but which we can't get, and a revised and up-to-date system of arc lighting is one of them. There are a good many reasons why that is not attainable ; the principal one, and one which especially applies to our case, seems to be that this lighting is done under contract with the municipality. The municipality has been endeavoring, as the bigger dog, to get away the bone from us for many years. The contract only extends for five years from time to time, and it seems as though that would preclude any attempt at improvement in the arc lighting service. For instance, the contract that we have now with the municipality has three years yet to run. We could put in a very much more efficient arc lighting system than we have to-day but the cost of that change, and the interest on that cost, with the probability of an entire loss at the end of the period, would render it very inadvisable and would counterbalance the saving which might be made. Of course, when the time comes that power will be transmitted from Niagara Falls, which we look forward to in the near future, changes, of course, will have to be made. It is not likely that we should use our present generators in the shape they are, as they are of varying sizes and it would be almost impracticable to employ them with synchronous motors to any advantage, unless separate sized motors were used with each dynamo ; the method that would have to be used would be no doubt the synchronous motor and the constant direct current machine. Whether that would deliver current to open or enclosed arcs would be a question that would have to be determined by any contract or any arrangment that might be made with that impracticable body, the municipality of the city of Toronto. (Applause). All the points have been so fully covered in Mr. Greene's paper, it scarcely leaves room for any consideration of the matter from a scientific standpoint ; but no doubt there are many of the members who would be very much more able to take up that side of the case than I would. I would like to hear from them.

The President : Why have you come to the conclusion that only synchronous motors would be used in the operation of direct current machines? Induction motors seem to be left out of consideration.

Mr. Wright : There are two points I presume that would come up, one would be the question of power factor, and I think, speaking without experience, that in a long distance transmission from Niagara Falls to Toronto, ninety odd miles, supplying from the same line to different stations on the route, and branches and so on, that the disturbance to the line, the drop in voltage caused by the varying load would be so great that the synchronous motor would have the preference. The variation in voltage would not matter so much if the initial cycles were kept constant. The synchronous motor would stand a certain considerable amount of variation in voltage if it were large enough and still keep up its speed by keeping in step with the generators at the Falls.

Mr. Greene : The result arrived at in Buffalo is that the synchronous motors were cheaper than the induction motors, and one has a much higher power factor than the other and could be very readily controlled.

Mr. Dion : I think we are to be congratulated on the character of the papers which have been read at this Convention and the manner in which the subjects have been treated, inasmuch as after the reading of each paper it has been stated that the ground is so fully covered there remained nothing to be said. With regard to synchronous motors versus induction motors for driving arc machines, I do not propose to go into the subject to any extent, but merely to state that in our case in Ottawa we decided in favor of the induction motor. The power factor, of course, is to be considered, but an arc load is a constant load and a full load so that you are working under a full power load factor. But yesterday during the visit to the sub-station of the Quebec Railway, Light & Power Company, I had occasion to see the synchronous motors started, and I could not help making a comparison between the elaborate and grinding noises of starting used there to the ease with which an induction motor is put in operation.

Mr. Greene : I suggest Mr. Dion should visit Buffalo and Boston, where they are operating a great many synchronous motors where they are started up about as easy as the induction motors.

The President : I don't want to switch this discussion off, but in Montreal they are operating about 1500 to 2000 h. p. synchronous motor of the old type of machine. On the other hand, there is being installed a 5000 h. p. induction motor. If we had to put in new apparatus for arc lighting purposes we should put in induction motors. I would call for further remarks or discussion on this paper on Arc Lighting.

Mr. Lambe : I would like to ask a question as to the resistance of the arc. You get a voltage across it; what is that? Resistance?

Mr. Greene : As near as I can size it up I think it is pure resistance, but an extremely variable one. Take it upon the alternating arc current you get a voltage practically across at the identical same point, but the resistance of the arc depends so much upon the temperature ; it is affected by the temperature of the arc. I have never been able to get any indication of counter e.m.f. in the arc. I do not see any reason why there should be any. It there is any it might be a very nice way of getting electricity from heat. They have never succeeded in it, so I think it is simply resistance.

Mr. Lambe : What is the power factor of that arc itself in the ordinary 60 cycle alternating arc ?

Mr. Green : One of the writers in his book gives the power factor of the arc varying from almost nearly one down to six-tenths. It depends very largely upon the grade of carbons which is used. Very hard carbons lower the power factor, conducting the heat away, making the resistance vary greater, whereas soft carbons conduct the heat away less rapidly and do not make the resistance vary so rapidly.

Mr. Lambe : If you have the power factor less than unity you must have condensation or reactance there, must you not?

Mr. Greene : You have a variable resistance which will give you a different power factor from unity ; that is, your resistance varies with your current (illustrates by diagram.) You have got a variable resistance there, the result of which is it will give you a power factor below one.

Mr. Martin : This is a very interesting subject to all of us, particularly managers of lighting stations, and Mr. Greene's paper has taken it up both from a theoretical point of view and also from a practical point of view which is interesting to the station men. I would say a short time ago I was called upon to decide for an arc lighting system for our own station and I started out ; I didn't like the look of the alternating arc light, it had its troubles ; a great many said the light quality was not pleasing. I returned a report in favor of c. c. arc, and I got myself very much disliked by the a. c. man ; he said I should put in a. c. I would like to ask Mr. Greene a question. Supposing we put in a 132 cycle alternating lamp or direct current, how do you compare those two? Are they favorable in comparison.

Mr. Greene: I don't quite understand.

Mr. Martin: Would you recommend putting in the high efficiency or 16,000 alternating arc or the direct current? How is the light quality or candle power?

Mr. Greene: The candle power from the alternating arc is less than from the direct current arc, slightly.

Mr. Martin: Has it less diffusion?

Mr. Greene: There is not the amount of light; that is, you don't get as many candle power. Take it from the candle power point of view, from your arc, and referring back to the diagrams given last evening in Mr. Ryan's paper, there is about five per cent. difference in candle power between a 450 watt alternating and direct current arc; that is, you get a little more light from the direct current than from the alternating; your distribution of your light is a little superior with your alternating, that is, you get more of mean spherical candle power; with your open arc lamp the curve will come down much lower, (illustrates by diagram.)

Mr. Martin: With the alternating arc light you get a better diffused light, but with the direct current you get a better light close by.

Mr. Greene: You get more light with your direct current than with the alternating. However, that is comparatively slight; it won't amount to over four or five per cent.

Mr. Leonard, jr: Practically no difference. I do not like to lead up to an endless discussion, but I do not like to have the convention left with the impression that there is too much altogether in favor of the direct current arc system. I am personally very much in favor of the simplest and most uniform system that can possibly be arranged for central station purposes, and for that reason I have, as far as possible, in installations with which I have been connected, adopted the single alternating current unit. The advantages of having a single machine which operates all classes of service, it seems to me, outweigh so much any little advantages that can be obtained by a variety of different kinds of machines is sufficient to warrant the use of A. C. generators only, and I believe that the results obtained with the alternating current arc, certainly for street illumination cannot be excelled by the direct current arc. As Mr. Ryan brought out last night in his very complete and interesting paper, the general distribution obtained from the alternating enclosed arcs and direct current enclosed arcs are on a fair basis of equality, both being superior to the direct current open arc. We all know what the old direct current arc lamps gave us in the way of illumination ; a heavy shadow, as was clearly shown last night, under the lamp, and an intense light at an angle of 45 degrees ; a wide difference in the illumination or intensity of the light, making the illumination very unsatisfactory ; a person driving under the light is first in deep shadow, then he drives out in an intensely brilliantly lighted space and his eye becomes so accustomed to that light that when he drives out into a little deeper shadow the illumination is most unsatisfactory. I had that experience for so long a time when I was in the central station business myself that I had it very deeply impressed upon me. The improvements made in the alternating current arc are very great. So far as the machine is concerned, viewing it from Mr. Greene's standpoint, it is very nice to push the machine with which you are connected and identified, and naturally, as a person connected with the working up to such a success as has been connected with the Brush multi-circuit machine, I don't blame him, and you can hardly get away from those things when you are so closely associated with them. But with the alternating arc you have the simplicity, you have the general illumination ; you have, with the proper arrangements, the highest efficiency, I believe ; you lose only about 2%, a trifle over, in your transformers ; you have inductance regulation ; you have a very small loss at full load, and the conditions of street lighting are such that the full load can be carried almost all the time, and the losses under these conditions are small ; the generator efficiency is very much higher and the efficiency of the system throughout is great. The power factor is another matter that depends upon the load, but that is also very high under conditions of full load such as pertain to the ordinary street lighting system. I might say I know of a circuit which operates very satisfactorily so far as the illumination is concerned, where the power factor closely approached 90 per cent. with inductance regulation. I do not wish to go any further. I presume we could discuss this for hours.

Mr. Greene : I thank Mr. Leonard for his compliments, but I wish to right myself ; I do not think he has quite grasped my conclusions. I would like to read the third one over again : "The alternating constant current enclosed arc system is best and most economical for plants which use large 40 to 125 cycle alternating current generators, the arc lamp load being a small part of the total output of the station."

Mr. Leonard, Jr. : That is correct. There is another point raised here, apparently not settled. Mr. Martin asked about the difference between 60 and 125 cycle arc. To straighten that matter out I would like to say that with the 60 cycle arc the power factor is very much higher than with the 125 cycle arc and the illumination is very little different; but the difference in the power factor is great; with the 125 cycle arcs, I think, so far as I have been informed, you are only able to obtain a power factor of about 67 and 68 and sometimes as high as 70, whereas 88 to 90 can be obtained with the 60 cycle arcs.

The President : It is to be regretted that we have not more time on our hands. On behalf of the Association, Mr. Greene, I convey to you the thanks of the entire assemblage for that paper and very much regret we cannot continue the discussion. I know there are many here who have a lot to say on this subject, and very feelingly too. If we have an opportunity before the convention closes I want to open up the discussion on this paper and also the relative merits of synchronous and induction motors for certain purposes. The next subject that we have before this Convention is one of vital and intense interest to us all ; it is unnecessary for me to say that the work done by our fellow member, Mr. Thomas, is known all over the world wherever lightning protection is used or desired to be used in connection with the protection of transmission lines. The subject of the paper is "Lightning Protection and the Static Interrupter." I have great pleasure in introducing Mr. Thomas to the Convention.

Mr. Thomas : Mr. President and gentlemen : In some ways I am rather unfortunate in having such a subject; it is rather an uninteresting one and difficult to present, and if I have made it too concise and brief I hope you will all make notes and ask for further explanations when I get through. I have tried in the paper to give an outline of the phenomena taking place as the result of lightning discharges, describing rather closely how the results are produced, then, in a rather brief manner, a description of the static interrupter, which is the thing I wish to bring out as a new adjunct to the lightning arrester in the prevention of short circuits in high tension apparatus.

Mr. Thomas at this point read his paper (which will appear in a future issue) and illustrated his remarks by means of a mechanical model.

The President: I feel incapable of expressing my appreciation of such a paper as presented by Mr. Thomas with his beautiful mechanical model; it is beyond my powers and I will leave that to some of the more eloquent members. I don't believe I am going too far in saying that the originator of any device which is contributory to the safe and proper protection of our lines from lightning discharges, which may affect not only our business interests but come into our very houses, has conferred a boon upon mankind; and I think we will all agree that Mr. Thomas in working out this device which he has explained to us has been instrumental in presenting a unique and very great safeguard to the entire business. The paper is now before you for discussion. I see that Mr. Thomas has asked that there be expressions from different parts of the country in regard to the experience with static discharges and lightning protection. I know there are a great many here in the vicinity of Quebec and Montreal and throughout Canada who have had very extensive experience in the protection of long distance transmission lines, and I think the members of the Association will be very much benefitted if we can hear concisely the practical experience of the members on this subject.

Mr. Lambe: I want to ask Mr. Thomas a few questions. In the first place, a plant struck directly by lightning discharge is gone sure?

Mr. Thomas: I am quite sure time and again lines have been struck by the direct or half of the direct stroke without being shut down. I can take a moment here to describe one instance. The Colorado Electric Power Company I think has a worse condition in regard to lightning to deal with than perhaps any other line in the country. They run about 25 miles from Canyon City up to the Cripple Creek mining district, and where they are 10,000 feet above the sea level and where the lightning is an every day occurrence, and where it comes so regularly that they set their clocks by it. The superintendent of that plant told me a few days ago that on June 14th of this year, provided nothing happened between the time he was talking to me and that time, they would have had a year in which they had not had the voltage off their line for a moment. They have one three wire line of 22,000 volts. They have frequently had their poles struck. I am quite certain they get direct strokes which jump their insulators and strike the pole and go to earth in that way, with the result that a secondary wave is sent along the wire to the apparatus. If, however, it is struck across close by the apparatus I don't believe there is much chance of it escaping.

Mr. Lambe : We understand then that the effect of an ordinary lightning discharge depends on where it strikes the line. Roughly speaking, what is the amperage and voltage of a lightning discharge?

Mr. Thomas : I remember that about ten years ago they used to do a little bit of guessing about that, but I have not heard of a case since that time.

Mr. Lambe : In crossing a body of water you have on the one hand a line crossing that body of water on towers or poles, and, on the other hand, a line going down underneath the river which is the hardest to protect against trouble or which would give you the least trouble?

Mr. Thomas : I should not anticipate trouble from either method installed now, with a full knowledge of the conditions and with cable manufactured as it is at the present time. It just depends on the local conditions.

Mr. Lambe : Then we understand that for protection from lightning you express no preference?

Mr. Thomas : The cable is always a more sensitive apparatus, but I should not anticipate any trouble.

Mr. Lambe : As to grounding the neutral or secondary of a 110 volt system, do you recommend it as far as lightning is concerned? Do you think it is desirable? Take a house circuit?

Mr. Thomas : It seems to me all those circuits which are liable to be touched by people, or which go around in wooden partitions, ought either to be grounded somewhere or equipped with a close set spark gap.

Mr. Lambe : In grounding that secondary, and having not only 110 volts for lighting, but take a power circuit of 5,000 or 10,000 volts, with a high potentiality of 30,000 or 40,000 volts, if you ground your secondary do you consider that increases the trouble on the primary lines.

Mr. Thomas : That is a matter to be considered in connection with the winding. If you have a 2000 volt circuit, if you are taking that from a 40,000 volt circuit, the difference between the earth potentiality and 2000 volts doesn't make much difference.

Mr. Lambe : The same thing would apply to grounding the neutral in high tension.

Mr. Thomas : Grounding the nuetral there introduces two sorts of effects; it prevents your getting more than say 6/10ths of the voltage between the line and ground. But one single ground produces a short circuit on the system. You have a certain advantage and a certain disadvantage. Which system is best depends on local conditions and on the voltage. Taking actual experience, I will say it is divided. I know of three lines, one of 40,000 and two of 30,000 volts in Colorado and California, that have not the neutral grounded. The plant of the Missouri River Power Company, 50,000 volts, is being put in without the neutral being grounded. Those who have grounded the neutral are in favor of it, and those who have not have managed to get along all right. I think probably on voltages as high as 30,000 volts it is wiser to ground the neutral point.

Mr. Lambe: There are two general methods of starting up a plant: Getting your voltage up to normal and then plugging in your switch; and then closing all your switches and turning on your throttle or opening your water wheel gate. In its effect on the line and transformers which do you consider is the best?

Mr. Thomas : Bringing up slowly, and, conversely, shutting down slowly.

Mr. Lambe: You would consider that of commercial importance?

Mr. Thomas: I think it is of commercial importance on anything above 20,000 volts. Where you have a high tension generator you must be more careful. The generator coil cannot be run in oil and the shape is so that you cannot put the amount of tension on. 10,000 volts is pretty near the limits.

Mr. Lambe : Barb wire, yes or no, do you think it is efficient as a lightning protector.

Mr. Thomas : That is one of those points on which we would like a little consideration; that has not been electrically considered. A wire over the other is a protection; if you can get a gridiron of wires, say a dozen, covering the lines and extending beyond, grounded thoroughly, I think you will get a very considerable degree of protection.

Mr. Lambe: You would not consider that it made any material difference whether it was iron, copper or aluminum?

Mr. Thomas : I think probably copper would be better. The protection against lightning disturbances is partly the absorption of the energy set up. If that is copper there would be more absorption. It is like it is a on a rotary transformer.

Mr. Lambe : What do you consider, generally speaking, the proper place to put your lightning arresters on the systems?

Mr. Thomas : Is this a power transmission system with its location of apparatus at the two ends or do you mean distribution through a city or town?

Mr. Lambe : A transmission system, more particularly?

Mr. Thomas : I only know of two or three cases where the protective apparatus is placed anywhere except at the station. Coming into the station from the line first could come the arrester, then the switches and busbars and so forth, if you have a sub-station on it at one side it should have its own protection. Occasionally where you have a district like Cripple Creek I believe it is well to have lightning arresters out on the lines.

Mr. Lambe what if you have a cable in your line?

Mr. Thomas : The protection of the cable is its protection against ground. You don't get any tendency to short circuit; but in protecting against grounds you ought to have lightning arresters near the end of the cables.

Mr. Lambe : In passing over an unusually high hill is it desirable to have something?

Mr. Thomas : That depends on how severe the conditions are. If your apparatus placed at the end will not protect, possibly something over a hill will be better, as there are secondary discharges that are very great.

Mr. Lambe : Taking a secondary system around a town, a 2,000 volt primary, what protection would you provide there?

Mr. Thomas : There is a case where actual experience of the plant, if it is an old plant, would have a good deal to do. I think arresters ought to be placed from three or four to one or two to the mile near the greatest number of transformers, and if there are any on the line, at the end of the line. There will be a reflecting point; you will have an increased potential there and it is a good thing to have an arrester there. The idea is that wherever a wave may be started it should reach the arrester before it is passed to any transformers.

A Member : Where there are high tension taps taken off and going from the junction point in several directions should you, besides having lightning arresters at each end, have one at the junction points?

Mr. Thomas : That would perhaps be a desirable thing if it is convenient; I do not consider that especially necessary. Really that sort of thing is a safety in itself; a wave comes down one line and strikes several different paths and it divides up, the energy does not all go in one direction.

A Member : Suppose a lightning discharge actually does hit the line, and supposing the line goes in different directions, would it jump to the pole or follow one of the other lines?

Mr. Thomas: If it fell on that line it would reach the end if the insulation was sufficient, and if it was not it would break down.

Mr. Dion: I think we are fortunate in having amongst us a gentleman with the cross-questioning abilities of Mr. Lambe, because he has been the means of eliciting further information which Mr. Thomas has been very ready to give, and which has been of considerable importance to me, because I have secured information which I had previously been unable to obtain. I remember reading Mr. Thomas' paper which he presented before the American Institute of Electrical Engineers in which I think he stated something to this effect, that many transformers which were supposed to be destroyed by lightning from passage to ground were really destroyed by short circuit. It occurred to me to make some tests on transformers which were destroyed by lightning with us since that time, and in nearly all cases we failed to discover any contact with the case of the transformer at all, and we concluded the trouble was due to short-circuiting rather than a contact to ground. I asked myself the question, that being the case, whether we could not ground our secondary system without increasing the liability to burn out the transformers. Some time ago at the convention of the American Electric Light Association at Cincinnati where we had some gentlemen who have been connected with high tension work and who dealt with the problem of line protection, protection to transformers and so forth, I tried to elicit an opinion and I failed, and I am very much gratified to hear what Mr. Thomas has said. I don't wish to close this discussion, in fact, I don't pretend to discuss the paper; I don't feel capable of discussing it at all, but while I am on my feet I would like to move a vote of thanks to Mr. Thomas for his very able paper. I fail to find words to express all that I feel on the subject, but I think that we realize fully the amount of trouble and hard work entailed in the preparation of a paper of that sort and the transportation of this apparatus and setting it up and all that it involves. This Mr. Thomas has done for us, and the very least we can do is to pass him a very hearty vote of thanks. (Applause).

Mr. Wright: I second that.

The President: It has been moved and seconded that the convention convey thanks to Mr. Thomas for this very able paper. I hear no dissenting voice, so it is carried. Mr. Thomas, we present you with the thanks of the Association for your paper. Out of courtesy to Mr. Thomas, who has asked for the experience of some of the companies operating with the protection of barb wire, I am going to state briefly our experience with 35 miles of transmission lines running into Montreal. On these lines in crossing over two rivers under two canals and under the street we have two and one-half miles in five sections of cable. Mr. Thomas has stated cable protection is slightly more hazardous than straight line protection. I may say that that line has been in operation continually for four years without lightning protection other than barb wire. I don't wish to be understood as advocating running lines without lightning protection other than barb wire, as only where you can get good ground connection I believe the barb wire will be effective, but that is an experience that I think possibly Mr. Thomas may be glad to hear; and to those in charge of operation I would say we feel absolutely confident in the protection of barb wire as we have been running practically without lightning arresters other than grounded barb wire without the slightest indication of any discharge. I may say that the grounding in my opinion is very essential. We use three barb wires and ground every 90 feet, and the ground wire is connected to the barb wire by means of soldered joints, the ground wire extending down to the bottom of the pole and placed in the ground at the time the poles were erected, and is protected from mechanical injury by means of three-quarter inch wrought iron pipe running down. The experience we have is to us, at least, conclusive. We have had no discharge and we have had conditions there that are conducive to having a break down.

Mr. Slade: Do you send the linemen up with that barb wire on the pole?

The President: Not when it is alive.

Mr. Burran: In regard to barb wire, the Montmorency Company tried it; they had two parallel lines. They undertook to put barb wire on the ends of the cross arms extending out a little further than the line wires and above them; we grounded every fourth or fifth pole. During that season we had several very severe storms during the working hours, and we had no trouble on the line that was so protected. On the other pole line we had considerable trouble; so we decided we would equip the other line similarly that fall, which we did; and the following summer we had troubles on both lines indiscriminately, just as if we had never had a barb wire on them.

The President: I want to call attention to the fact that Mr. Burran states the poles were grounded every four or five poles. There have been several installations called to my attention grounded in the same way that have not been satisfactorily protected from lightning discharge.

Mr. Schweatmann: While lightning protection has been very ably discussed, I really believe that the lightning trouble is not so much the most serious to our high tension lines now as static discharges, and I believe the object lesson shown here by Mr. Thomas by his model is one we ought to bear most carefully in mind. If central stations will learn to appreciate that high voltage transformers have similar strains if switches are placed improperly to steam pipes and water pipes and all that sort of thing; and with a proper high tension line with proper interrupters or static dischargers, I believe we will do away with a great deal of our trouble. I am speaking from experience. I have seen most of the high voltage lines through Colorada and California and I have found that lightning is by no means one-tenth, I dare say 100th of the source of trouble, as it was five or six years ago; it is the static strains now, particularly on long distance transmission lines, that worry the producers of electrical energy. If we bear in mind the last few paragraphs of Mr. Thomas' paper and treat our high voltage lines with more consideration I think we will do away with a great deal of the trouble.

GENERAL BUSINESS.

Mr. Dion: Yesterday I gave notice in the report of the Committee on the Constitution of amendments which we proposed to bring before the Convention. It is necessary to be disposed of at this meeting that the formal motion be made to-day; I will therefore move, seconded by Mr. Wright, that the amendments to the Constitution of which we gave notice yesterday be passed, as you understand this is to remain on the table until some other sitting.

The President: I understand that matter must be referred to the Committee and not placed before the Convention. I will therefore refer this motion for amendments to the Constitution to the Committee which has had this matter in hand in past years, the members of which I am not quite familiar with.

On motion of Mr. J. J. Wright, seconded by Mr. Reesor, the session was adjourned.

THIRD DAY.

10.45 o'clock a. m. the President in the chair, called the Convention to order.

The President: The first matter to be attended to this morning is the election of officers for the ensuing year, but before proceeding with that I will ask Mr. Reesor, chairman of the Striking Committee, to make his report.

Mr. Reesor: Mr. President, the Select Committee to strike the standing committees for the current year beg leave to report as follows:

REPORT OF SELECT COMMITTEE TO STRIKE THE STANDING COMMITTEES.

Committee to confer with Underwriters: Mr. P. G. Gossler, chairman, Edw. Slade, A. A. Dion, Ald. Sadler, A. Sangster and J. J. Wright.

Committee on Statistics: Messrs. A. A. Wright, M. P., K. B. Thornton, D. R. Street.

Committee on Arc Light Rating: Messrs. Higman, Gossler, Thornton, Yule, Robertson and A. B. Lambe.

Committee on Legislation for Quebec: Messrs. P. G. Gossler, E. A. Evans, Geo. U. G. Holman, A. Sangster. With power to add to their number.

Committee on Legislation for Ontario: Messrs. Yule, Reesor, A. A. Wright, M.P., Hunt, Dion, Breithaupt, McCulloch and J. J. Wright. With power to add to their number.

Committee on Standardization of Accounts: D.R. Street, G. U. G. Holman, A. A. Wright, M.P.

The first named in each case to be convenor.

All of which is respectfully submitted.

B. F. REESOR, Chairman.

The President: You have heard the report of this Committee.

Mr. Reesor moved, seconded by Mr. J. J. Wright, that the report be received and adopted. Carried.

The President: I will ask Mr. Dion to report on amendments to the Constitution.

Mr. Dion: I regret the time is so short it will not be possible to go into this thing in detail. I beg to move, seconded by Mr. J. J. Wright, that the Constitution as amended be adopted. There have been quite a number of amendments made and it would take a long time to go through them, but as I stated before, they are amendments in form and in wording rather than in the sense, which has been left practically as it was before; and if you are satisfied that your committee, who have studied this thing very carefully and have had the matter in hand now for two years, have done what is best for the Association, perhaps you will be satisfied to pass the amendments without taking them up in detail. If, on the other hand, you think this matter should be taken up and discussed clause by clause by the general meeting, then it will be in order to lay the matter over until next year, because it would not be possible to do it this year. However, I make this motion and it is for you to decide what is to be done with it.

Mr. J. J. Wright: In seconding that motion I would say that if there is no objection to the amendments to the Constitution it would certainly be as well for this to be put through at this meeting; in fact, there is no change from the amendments that were determined on at the last convention. Those who were present at the last convention will remember the question of membership was taken up and it was divided into three classes and fees arranged and so on; there have been no changes whatever in those arrangements; they were all passed at that convention and simply crystallized in this new amendment to the constitution, so that if that is satisfactory to the meeting it would be very much better in the interests of the Association that it be passed now.

Mr. A. A. Wright: Who formed that committee, so that I may judge of their mental capacity?

Mr. Yule: I had the honor of being a member of that committee.

Mr. Dion: Mr. J. J. Wright, Mr. Yule, Mr. A. B. Smith and myself.

Mr. Yule: I had the draft for many days and went over it very carefully. The by-laws are made more modern and are more adapted to our present condition. I think the Association should pass them without losing any more time.

Mr. A.A. Wright: I might say if Mr. Yule endorses it I am quite satisfied it is all right.

The President: The matter has received very careful consideration from the Committee. I know that it will be to the interests of the Association to have this matter passed. I don't remember the exact wording of the motion, but it has been moved that the Constitution be amended and altered as per the report, according to notice given yesterday.

On a vote having been taken the motion was declared carried.

Mr. J.J. Wright: I would move, seconded by Mr. A. A. Dion, that the most cordial thanks of this Association be tendered to the following ladies and gentlemen and organizations: To the committee of ladies who have entertained the visiting ladies in connection with the Convention; the local committee who have had charge of the arrangements in connection with the present Convention (It is unnecessary for me to say anything as to how these arrangements were carried out and how satisfactory everything has been and the pleasure we have all derived from being present); to the Quebec Railway Light and Power Company, for their courtesy and the work they have done in ministering to the entertainment of the members; to the Jacques-Cartier Electric Company; The Canadian Electric Light Company; the members of the press for the reports given of the proceedings; Mr. Frederic Nicholls, Vice-President and General Manager of the Canadian General Electric Company for the excursion which we are to have this afternoon; the Corporation of the City of Quebec for the welcome extended to the Association; the rector of Ste Anne de Beaupre, Father St. Denis and Father St. Pierre, who so kindly received the members at the Shrine of St. Anne and went to the trouble of starting up the electric light plant for the entertainment of the members; to Mr. Langevin, the electrician of the Chateau Frontenac for his able assistance to the Local Committee in connection with the electrical illuminations; to Lieut.-Col. Wilson, R.C.A., and the Royal Canadian Artillery Band; to Mr. Russell Spaulding of the National Electrical Improvement Company, New York, who superintended the lighting decorations.

The President stated the motion and said he would like all to give their assent to it by a very hearty "yes", which was done and the motion declared carried unanimously.

Mr. Dion: I would suggest that the Secretary hand a copy of this resolution to the newspapers here in order that it may be properly inserted.

The President: We will take that as a suggestion.

Mr. J. J. Wright: Also I should have said that a copy of this resolution be forwarded to each of the parties interested.

SELECTION OF PLACE FOR HOLDING NEXT CONVENTION.

The President: Will any person here make any suggestion as to that?

Mr. J. J. Wright: As it seems nobody else wants it, I have very great pleasure in tendering an invitation to the members of the Association to meet next year in the city of Toronto. (Hear, hear). I know we are up against a hard proposition to put you up anything that will equal what we have received here in Quebec, but we will try. I will not say we will do better, but we will try to get as near to it as we can.

Mr. Dion: I move seconded by Mr. Leonard, that Mr. J. J. Wright's invitation to hold the next convention in Toronto be accepted.

The President put the motion which, on a vote having been taken, was declared carried, and Toronto fixed as the place for holding the Convention in 1903.

ELECTION OF OFFICERS.

The President: I will now call for further nominations for the office of President.

Mr. Dion: I have much pleasure in nominating the present incumbent of the office of 1st Vice President, Mr. B. F. Reesor, of Lindsay (Applause).

The President: Before proceeding to call for further nominations I may say according to the amendment to the Constitution, which amendment was passed last year, only the active members should vote.

The President: Are there any further nominations for the office of President? There being none, I will ask the Secretary to cast a ballot for Mr. Reesor.

The Secretary cast the ballot.

The President: I have great pleasure in declaring Mr. Reesor elected President of the Canadian Electrical Association.

The President : Nominations are now in order for the office of 1st Vice President.

Mr. Dion : I have much pleasure in nominating Mr. Edward Slade, of Quebec, who is now 2nd Vice President. (Applause.)

The President : Are there any further nominations for the office of 1st Vice President ? There being none, I will direct the Secretary to cast a ballot for Mr. Slade as 1st Vice President.

The Secretary cast the ballot.

The President : I have pleasure in announcing Mr. Edward Slade as 1st Vice President.

The President called for nominations for the office of 2nd Vice President.

Mr. Yule : I have much pleasure in nominating Mr. K. B. Thornton, of Montreal, as 2nd Vice President.

The President called for further nominations; there being none, the Secretary was directed to cast a ballot for Mr. Thornton as 2nd Vice President.

The Secretary cast the ballot, whereupon the President declared Mr. K. B. Thornton elected to the 2nd Vice Presidency of the Association.

The President : Nominations are now in order for the office of Secretary-Treasurer.

Mr. Purcell : I take pleasure in nominating for the office, our present Secretary-Treasurer, Mr. C. H. Mortimer.

The President called for further nominations ; there being none, Mr. Yule was directed to cast the ballot.

Mr. Yule cast the ballot, whereupon the president declared Mr. C. H. Mortimer re-elected to the office of Secretary-Treasurer.

The President called for nominations for the re-election of five members of the Executive Committee. Messrs. Robins and Fiske were appointed as scrutineers. The President read the names of the Committee of last year.

The ballots having been distributed and a vote having been taken, the President announced the following five members re-elected to the Executive Committee : Messrs. J. J. Wright, A. A. Dion, John Yule, O. Higman and A. Sangster.

The President called for nominations for five additional members to be elected to complete the Executive Committee.

Mr. Yule placed in nomination Mr. P. G. Gossler.

Mr. F. Thomson placed in nomination Mr. A. A. Wright, M.P.

Mr. Dion placed in nomination Mr. F. H. Leonard, jr.

Mr. Leonard : In regard to my nomination, while I am eligible as designing and consulting engineer to membership on this Executive Committee, yet my connection with the manufacture of motors is such that I am afraid somebody else had better act. I beg to decline. I think the precedent has been established by Mr. Nicholls, who has taken the position that no one in the manufacturing or supply business should be a member of the Executive, and I feel very much as Mr. Nicholls feels. While I would be willing to do all I could to assist the Association and forward its interests, yet under the conditions I think I had better decline.

The President : Under the Constitution manufacturing members are not eligible to office. I think, Mr. Leonard, you are not eligible to membership on that committee.

The President called for further nominations.

Mr. Yule placed in nomination Mr. G. U. G. Holman.

Mr. Reesor placed in nomination Mr. F. C. Martin.

Mr. Dion placed in nomination Mr. John Murphy.

Mr. Fred. Thomson placed in nomination Mr. A. B. Smith.

Mr. J. J. Wright placed in nomination Mr. E. A. Evans.

Mr. Burran placed in nomination Mr. L. Denis.

Mr. Reesor placed in nomination Mr. H. O. Fiske.

Mr. Lambe placed in nomination Mr. Wm. Bourne.

Mr. Reesor placed in nomination Mr. Gordon Henderson, Hamilton.

The President called for further nominations. There being none he declared the nominations closed.

The ballot having been passed and a vote having been taken, the President announced the following five members elected to complete the Executive Committee: Messrs. P. G. Gossler, E. A. Evans, A. B. Smith, A. A. Wright and G. Henderson.

The President called upon Mr. Dion to present his paper on "The Use of Storage Batteries in Electric Distribution Systems."

Mr. Dion presented his paper, (see page 128.)

The President : Gentlemen, you have heard this very valuable and interesting paper on a subject which many of us are not very familiar with. However, I see some here who have had quite extensive experience with storage batteries, and I will ask that they kindly give the Association the benefit of their experience when the paper is open for discussion. The paper as presented by Mr. Dion is now before you and I will ask Mr. Reynolds, of Philadelphia, if he will kindly open the discussion on this paper.

Mr. Reynolds : Up to the present time, I do not believe that the subject of storage batteries has received a great deal of attention in Canada. I presume that you are all aware of the fact that this has become a question of the greatest importance in the United States. I do not feel justified in discussing the paper which has just been read, because I represent the manufacturer, but I will be very glad to answer any questions and I hope I shall have such opportunity. I would like to consider with you the various systems in operation here. Years ago during the early development of the storage battery in the United States, the question of its use was influenced chiefly by the increased economy of operation. By improving the the load factor of the power station, obtaining a full load on the generator for 24 hours a day, and smoothing off all of the fluctuations, there is no question but that a saving ranging from 20 to 33 1-3 per cent. can in general be obtained. In Canada the chief proposition before you is water power, and I am convinced that the storage battery in the future is to be one of the most important adjuncts in the development of this power. As I have just said the chief point in view when storage batteries first opened in the States, was probably the idea of cutting down the coal consumption, and we found in approaching managers and engineers that this was the question which appealed to them most. Of course that point is indisputable, but one of the facts that appeals most strongly to the manager and engineer at the present time is the position which the battery fills as a relay in the station. A very interesting thing recently occurred in one of the largest lighting systems in the United States. In one of their stations in which a battery is installed, a steam pipe in the boiler blew out one day right at the time of the very heavy load. They allowed the steam to run down as low as possible, I believe to about seventy-five pounds. As the steam pressure dropped and the load on the generator sagged, the load on the battery increased until it finally carried the entire peak. They practically took everything out of the battery which was there but they got safely over the trouble and thus saved the day. There is another point, briefly, which I believe will appeal to you gentlemen in Canada probably more than any other, and that is the combination of lighting and railway interests in one ; from the standpoint of the transmission line and from the standpoint of the generating machinery. You take the case referred to in Mr. Dion's paper. This is the plant in Hamilton in which they transmit their power about 33 miles and distribute it to the street railways of Hamilton and to all of the lights. They are taking all that power and lighting from the same busbars at the substation. The battery absorbs all the fluctuation of the railway load, thus preventing the changes in voltage which would otherwise occur. We have with us Mr. Martin, who was at one time connected with this Company and I hope that he will tell us something by actual experience of what has been done there. We visited the railway plants here in Quebec. They are running from large water wheels, with a highly fluctuating load and they get beautiful regulation. While I was there it was absolutely perfect, but I was impressed with the fact that everything was dependent upon the governor. If for any reason that governor should get out of order, the most serious trouble would result. There is one other minor point which I want to bring out which will connect with one of the previous papers referring to static discharges ; and that is the fact that the storage battery is an excellent lightning arrester. Where batteries are installed it is practically impossible to get a discharge through the generating machinery. The battery is next the line, and if the lightning gets that far it meets the enormous surface of lead plates and is dissipated. I am very much pleased to know that the Association in Canada has taken up the storage battery question, and I believe that the subject is one that cannot receive too serious consideration. It has become a question of the greatest importance in the United States, as is attested by the fact that from two to three papers upon this subject have been read before most of the Association meetings during the past two or three years.

Mr. A. A. Wright: Have you had any experience with and do you advise its use as in case 5 which Mr. Dion mentions where there is merely an alternating generator used.

Mr. Reynolds: I do not know of any installation employing a pure system of alternating current generation and distribution, in which a battery has been installed for the purpose of carrying a peak load. There are a great many stations where the power is generated by a large alternating current unit and distributed by alternating current and direct current for light and power. In such cases where a portion of this distribution is by direct current, batteries have been installed for the purpose of removing the peak from the direct current end of the system, and for regulating the fluctuations of this load. Upon such systems the battery is generally placed across the direct current end of the rotary or motor generator, and very often in times of emergency or trouble the rotary has been reversed, the battery running the direct current end as a motor thus supplying alternating current to the general system. I would not by any means recommend an indiscriminate use of batteries. There are many cases in which it would be poor policy to put them in, but I do think that each case should be investigated by itself and doubtless there are many systems in this country which would benefit largely by their introduction.

Mr. Thornton: I have a short communication from Mr. John Murphy, of Ottawa, and with your permission I will read it: "The statement contained in the eighth paragraph of Mr. Dion's paper is one to which I would like to direct especial attention. It reads as follows: 'So many successful applications (of the storage battery) have been made within the past decade that the electrical engineer cannot now afford to ignore the storage battery as a factor in the design of electrical plants for light or power supply.' In other words, a few years ago a storage battery installation was looked upon as the luxurious appendage of a power plant; to-day it is coming to be regarded as an absolute necessity; and, this is quite as true when applied to the financial side of the engineering problem as it is in connection with the successful operation of the plant. At the Niagara Convention of the Canadian Electrical Association, held in 1897, Mr. W. A. Johnson's able paper on the "Applications of the Storage Battery", and the discussion which followed its presentation, awakened anew the interest in this question which literature on the same subject had already created in the writer. Investigations covering the intervening period together with personal experience gained in connection with the operation of a storage battery plant, have made him as ardent an advocate of the use of storage batteries, in many cases, as if he were an accumulator manufacturer or one of his enterprising sales agents. A striking illustration of the noble manner in which a storage battery will come to the rescue of a generating plant occurred in Cincinatti during the recent Convention of the National Electric Light Association. A terrible storm occurred about an hour before noon on the morning of May 20th, and darkness prevailed to such an extent that even railway trains were compelled to stand still because all signals were invisible. All places inside and outside, required artificial illumination and as the storm, and consequent darkness, approached very rapidly, no provision for handling the enormous peak which immediately arose in the lighting load curve, could have been made at the power house at the time, but the battery which was installed at the centre of the city quietly discharged while the storm lasted, 5,000 amperes on each side of the three wire system—as shown by the recording ammeter charts—although the maximum overload rated capacity of the cell was only 4,000 amperes, and neither the users of light or the central station people were inconvenienced in the slightest degree. It is instances of this description, many of which on a smaller scale have been witnessed by the writer, that endears the storage battery to the central station man. In my opinion no street railway plant should be operated without an auxiliary storage battery. A street railway plant has naturally a variable load, and it needs an accumulator, which is analagous to a stand pipe in a city waterworks system, into which may be placed or out of which may be taken such an amount of energy as may be represented by a curve showing the extreme load changes. In this particular a storage battery has two very important bearings on the generating plant in regard to its first cost and in regard to its operation. The size of the generator and its prime mover, whether water wheel or steam engine, need only be large enough to supply the average load. If a battery is installed to take care of the fluctuations, and if the generator is steam driven the whole plant can be operated more economically when working under full load conditions, while if the generator is driven by water power the question of regulation is eliminated and energy may be stored during periods of light load and then distributed during such times as it is most needed. The constant load which is maintained on the wheels does away with the wear and tear on the gates and the jarring which the wheels and generator receive when operating without a battery. The astonishing results which have been obtained in maintaining absolutely constant pressure on circuits equipped with storage batteries, have been made possible largely by the designers of the differential booster and to them too much credit cannot be given."

Mr. Martin : I have had experience with our battery in Hamilton. It was put in particularly for regulation purposes, for the street railway, power and lighting, all off the same generator. We did start off with the idea of running two transmission lines so that we could keep our power and railway on one side and the lighting load on the other. We found that by using the battery we were able to regulate all off the same generator ; in fact we could regulate within two per cent. and the lights were very steady. The battery is a very useful thing in railway work ; in fact, lighting companies could hardly get along without it ; that is if they tried to work both services off the one machine. The batteries are used up there for starting the rotaries and for the car barns during the night hours. We had occasion to shut down our transmission lines once, to renew an insulator, and we kept up the street railway service for about 20 minutes with our battery. I think Mr. Dion's paper pretty well covers the matter ; and those interested in the battery question, if they go into it with some of the battery manufacturers, can easily demonstrate and bring the thing out very clearly, much more so than I could, showing its utility and value. But I must say in Hamilton the batteries have been in a year and a half and they practically do as well as they did when they were installed. One thing about the batteries that we were anxious and frightened about was that we would not be able to keep them in good shape, that they would deteriorate materially. We found no trouble in Hamilton. The battery probably looks as well to-day as it did when we put it in first. We have been able to carry our railway loads in times of emergency when we could not have done it otherwise.

The President : Have you any direct current system aside from your railway service ?

Mr. Martin : We have a 250-volt power service which is not used with the battery at all.

The President : You use the battery simply for the railway ?

Mr. Martin : For the railway peaks.

The President : What capacity have you got installed ?

Mr. Martin : 400 ampere cells.

Mr. J. J. Wright moved, duly seconded, that the thanks of the Association be tendered to Mr. Dion for his paper on the storage battery.

The President put the motion which, on a vote having been taken, was carried amid applause.

The President : It is always to be regretted that we have not unlimited time when such an interesting paper as this is presented.

Mr. Dion : I do not want to take up too much time, but I would like to impress upon you the significance of what Mr. Murphy has said in his discussion on this paper. What Mr. Martin has said regarding the plant in Hamilton shows in a general manner all that the storage battery will do. I think the Hamilton plant shows the utility of the battery in all its different phases. But the value of the battery as an emergency reserve was never, to my mind, illustrated in such a striking manner as in the instance which Mr. Murphy mentioned. I happened to be there at the time in Cincinatti ; we had a sort of a cloud burst ; in the space of a few minutes it changed from day-light to almost absolute darkness, and just as he says, there was no possibility of getting the machinery started quickly enough to meet the demand for light ; they simply could not do it, and while they were trying to do it the storage battery was doing the work, and the recording ammeter showed that the battery had been discharged at 5000 amperes or 25 per cent. over its greatest rate or capacity. That impressed me very forcibly ; there was no accident, the storm went on and everybody had their lights ; there was nothing wrong, but if there had been no battery it would have been very wrong indeed. I find a great many people dismiss the storage battery subject by saying a battery costs too much, the first cost is terribly high, we cannot touch it. My plea was this, that you should not dismiss the subject in that way, but that you should take it up in connection with your plant and see what it does cost and possibly you can solve the problem in favor of the batteries, and if it results in economy, even though it is a very small economy, I think you should use the battery because you have the other advantages, better regulation, emergency reserve, and so on.

Mr. Lambe : Batteries are useful, I suppose, in connection with railway work. Would some member give us roughly the weight per h. p., the cost per h.p. and the average weight of maintenance.

The President : And may I add to that, I would like to know what the overloading capacity is ? Mr. Reynolds will you give us information on those points ?

Mr. Reynolds : In reply to your question, referring to the overload capacity of storage batteries, it will be necessary for me to know what you mean by that. I do not know whether you are all familiar with the ways in which batteries actually operate. In railway work it is very different from central station work. In railway work we have what we term "fluctuations," these being heavy changes of load lasting for a few seconds or a few minutes only. We do not term these sudden increases in loads "peaks." We apply the term peak to the long and gradual increase of load which you find during the heavy hours upon the average lighting circuit. For example : take the railway plant right here in Quebec. While I was standing yesterday before the ammeter, the load fluctuated from 200 to 1,500 amperes within two or three minutes. In a case of this kind we would determine the average load by taking a series of five or ten seconds readings. This average load only would be placed upon the generator, and the battery used to take the fluctuations above and below that average load. The result of this is that the battery actually discharges for a very short portion of the time only, although as usually installed it will have sufficient capacity to maintain a load represented by the amount of the fluctuations for a period of one hour continuously. Used in this way a battery has a very considerable overload capacity but it is impossible to state just what it is. In cases of emergency I have seen momentary overloads as high as 100 and even 200%. In central station work, the battery is installed for the purpose of carrying a peak lasting for several hours, and the output of the battery is therefore rated in actual ampere hours. For example, we have a peak which lasts three hours, and say it is equivalent to 4,000 ampere hours. Now, what the overload capacity of a battery installed for this purpose is depends entirely upon the size of battery installed. If a battery rated at 4,000 ampere hours is installed, its capacity should be considered exhausted upon the peak. It is advisable in installations of this kind to install extra plates in each cell so that a certain reserve in capacity is obtained, and of course this reserve represents what might be termed the overload capacity of the battery. Now, in regard to the other questions. In reference to the weight per horse power, we make so many different types that I can answer this in a general way only. We range anywhere from 60 pounds up to 300 pounds or more per horse power hour, taking into consideration our latest types of automobile batteries, and our heaviest types of central station batteries. The latter type, of course, we do not try to make light. The cost of batteries also varies considerably. Expressed in k. w. hours the cost of central station lighting batteries will range from $50 to $125 per k.w. hour, depending upon the size and upon the rate of discharge. In railway batteries it will range somewhere around $100, at the hour rate. I have seen it down as low as $85 and as high as $125. That is the complete cost, of course. As to the depreciation of these plates. There are in the neighborhood of 400,000 h.p. hours in batteries in operation at the present time in the United States. The depreciation of these plants depend within certain limits upon the conditions of operation, and I find that the human factor has a great deal to do with the cost of maintaining batteries. I have seen some batteries, which within three or four years show very considerable signs of depreciation, due to the abuse they have received at the hands of the man who is supposed to take charge of it, but I am glad to say that these are isolated cases. On the other hand many of our earlier plants, which have been in constant operation for seven or eight years show very little, if any depreciation. Our experience extending over 10 years and covering several hundred plants shows that when a plant is operated with ordinary intelligence the depreciation to be expected can be taken care of by an annual charge of not to exceed 6 per cent. It is only fair to state that the depreciation of a battery is affected by the amount of work it is called upon to do, and this figure of 6 per cent. is given upon the assumption that the battery will be called to do a normal amount of work. Were this amount of work materially reduced, the depreciation would be considerably lessened.

Mr. Lambe : That would not include maintenance ?

Mr. Reynolds : That is what we call maintenance. We do not consider there is any such thing as depreciation, and I was incorrect in using this term. If you put in a battery to-day, and at the end of four or five years you find it necessary to renew some of the positive plates, you necessarily will install plates of the most recent design, which will involve all improvements of the four or five years. The result is that if the battery be properly maintained it is maintained up to the standard, and the battery has no depreciation. We call it maintenance, and that is really the correct term applied to a battery.

Mr. Lambe : Thank you.

The President : We are very much indebted for that information.

The President : I will call on Mr. Evans to present his paper, the subject of which is "Electric Suburban Railways". (See page 127).

Mr. Evans: I might preface my remarks by stating that the subject of the paper is more applicable to steam railroad managers than to an electrical convention; at the same time, it points out the great advantages of electric railways. With reference to Montmorency, I think it is important to mention that in 1901 the Kent House and all the property that we saw yesterday was not in existence; that is, the building was there, but it was not open to the public, and it had not been thought of as a place of resort for the citizens of Quebec, yet notwithstanding that you see we carried 64,000 passengers last year and only 17,000 the year previous.

The President: You have heard this very interesting paper, which we are all the better able to appreciate after our very delightful excursion of yesterday afternoon. While we naturally would conclude that rapid development of the road would have been made under the able management of Mr. Evans, it hardly occurred to me there would be such rapid progress as shown by Mr. Evans' paper which is now before you for discussion.

Mr. Evans: I might add for the information of the members one feature, that is the absolute necessity of having standard railway car-wheels M. C. B. standard. Of course, they are not suitable and you cannot run them over city tracks; the flange is too deep, but if you want a high speed suburban service it is absolutely necessary you should have standard wheels so that there is no danger of their running off the tracks at the different frogs and switches.

The President : You must have found it very much to your advantage to have put in the ballast you have there and the heavy rail ?

Mr. Evans : Undoubtedly. That was one of the points I omitted to mention. Before we put in the double track we were operating on the old track, 56 pound rail, with ordinary old fashioned single fish plates. The traffic increased to such an extent that we had positively to double the track the first six or seven miles, and in doing so we put in 70 pound rails and a special fish plate three feet in length, double angle, an angle on both sides ; the result of that has been very satisfactory, so much so that my electrical engineer has tested the power taken in running the cars on both tracks. On the old track it takes 10 h.p. more to operate our 48,000 pound car than it does on the new track, showing the advantage of having the heavy rail and good joints, which, in my opinion, is more important than the heavy rail. The broken stone ballast whilst making a more rigid roadbed has proved very beneficial in bringing up the old track and also in adding to the life of the ties.

Mr. Reynolds : I would like to ask Mr. Evans a question in regard to the distribution of his power. Is there a sub-station on the road beyond the power house, or is all that portion of the road fed direct from the power house. I would also like to know how long this portion of the road is.

Mr. Evans : The power is taken from a 600 k.w. a. c. d.c. generator at Montmorency, seven miles from Quebec ; there on the d.c. end we distribute seven miles to Quebec and seven miles from Montmorency, making 14 miles direct distribution on that machine. We send a.c. current to Ste. Anne de Beaupre, 14 miles away at 11,000 volts ; there it passes through a 200 k.w. rotary transformer and feeds back seven miles in this direction or westerly to meet the d.c. current coming forward from Montmorency, and 7 miles easterly from St. Anne de Beaupre to the end of the line.

Mr. Thornton : Without wishing to stop any future discussion on this paper, I would like to move a very hearty vote of thanks to Mr. Evans for his interesting paper. The possibility of investments and profitable returns in suburban railroads and the results obtained with the enterprising management of Mr. Evans is a revelation to most of the members here present. There are many railroad men here and we would like very much to hear their opinions on the subject. Again, I would like to move a hearty vote of thanks to Mr. Evans for his paper ; it has been extremely interesting.

Mr. Dion : I second the motion.

The President put the motion which, on a vote having been taken, was declared carried with applause.

The President : If there is no further discussion on Mr. Evans' paper I will ask Mr. Yule and Mr. Dion to escort our newly elected President to the Chair.

The President elect, Mr. B. F. Reesor, was escorted to the chair by Mr. Yule and Mr. Dion amid applause.

Mr. Reesor: Gentlemen, I thank you for the honor you have conferred upon me in electing me as President of your Association,—the highest honor in the gift of the Association. I deem it an honor, and I felt a little timidity in accepting the office, but it seems to be so unanimous that I realize I will have the hearty cooperation of the executive and members of the Association, and I think we will probably be able to get along. I am extremely pleased that our next meeting will be in Toronto; it will be near our own home and we hope to see you all at that Convention next year with a large increase in the membership. I notice by the clock that we have very little time to spare, and if there is any more business to proceed with we will now take it up. I thank you again for the honor you have conferred upon me. (Applause.)

Mr. Dion : Mr. President, I would like to take this first opportunity after your installation to propose a vote of thanks to our retiring President, Mr. Gossler. You, as a member of the Executive Committee, know better perhaps than the members in general the zeal which Mr. Gossler has displayed in connection with his office. During the organization of this particular convention I have been closely associated with him, not as a helper to any extent, but we have been in very frequent communication, and I have been able to realize how very great a portion of the load he has had to carry and how much zeal and activity he has displayed and how much we owe to him for the success of this Convention, which is very great; and it gives me much pleasure to move this resolution which I have no doubt will be carried enthusiastically.

Mr. Leonard : I second the motion.

Mr. Reesor : I can assure you the Executive Committee and the officers have found Mr. Gossler a most indefatigable worker and hustler, as the saying is, from away back, and I am pleased that he will be on the Executive still, and I may say just here that I am very much gratified with the personnel of the Executive for the coming year. You have heard the motion that a hearty vote of thanks be accorded our late President. All in favor of that motion will signify it by standing up.

The members rose in a body, Mr. Leonard commenced, and was joined by the members in singing "For He's a Jolly Good Fellow," after which three cheers and a tiger were given for Mr. Gossler.

Mr. Gossler : Mr. President and members, I thought the time had arrived when I had escaped and would not be called upon to make a speech. I simply say I thank you very much, and wish to take this occasion, as I have personally, of thanking the committees and the entire Association for the support they have given me during the past year. I bespeak for our President, Mr. Reesor, the same enthusiastic support that has been given to me. (Applause).

On motion of Mr. J. J. Wright, duly seconded, the Convention adjourned to meet in Toronto in 1903.

SOCIAL EVENTS.

On Wednesday afternoon the delegates were conveyed by special cars to the substations of the Jacques Cartier Electric Co., and the Quebec Railway Light and Power Co., a halt being made at the latter company's car barns for the purpose of hearing Mr. Lambe's interesting paper.

By courtesy of Lieut.-Col. Wilson, R. C. A., the Royal Canadian Artillery Band gave a promenade concert on Dufferin Terrace, on the evening of June 12th. The delightful music, coupled with the beauty of the electrical decorations, drew to the spot thousands of the citizens who shared with the visitors the enjoyment of the occasion.

The trip by special steamer around the Island of Orleans visiting en route the docks, harbor and site of the new Quebec bridge, by invitation of Mr. Frederic Nicholls, Vice-President and general manager of the Canadian General Electric Co., proved most enjoyable, and brought to a fitting close the convention.

About one hundred members and invited guests attended the annual Association banquet at the Chateau Frontenac on the evening of the 12th June. Among those present were the following: Hon. L. R. Pelletier, Hon. G. Tanguay, C. Baillairge, H. M. Price, H. Reed, E. Pope, F. Carrel, O. J. Begin, J. J. O'Flaherty, Dr. Stewart, Dr. Phillips, P. Meyers. The tables were attractively decorated with flowers and miniature electric lamps. The President, Mr. P. G. Gossler, ably fulfilled the duties of chairman and toastmaster. The toasts were "The King" "The President of the United States" "Our Guests."

At 2 p.m. on Thursday a trip was made to the celebrated Montmorency Falls and the shrine of St. Anne de Beaupre. The train was in charge of Mr. Ed. A. Evans general manager of the road. At the falls an inspection was made of the generating station, from which current to operate the road is transmitted in both directions. This station has for many years been in charge of Mr. Lewis Burran, who was on hand to give all information. This was the first successful long-distance transmission line to be put in operation in Canada. When Mr. Fred. Thomson, then electrician of the Royal Electric Co., Montreal, suggested the possibility of lighting the streets of Quebec by arc lamps supplied with current generated at Montmorency Falls, he was the subject of much ridicule, which changed to admiration when he had successfully demonstrated the practicability of his ideas.

ELECTRIC SUBURBAN RAILWAYS.

By E. A. Evans.

A paper was recently read by Mr. C.H. Davis, C.E., before the Canadian Society of Civil Engineers, on the competition of steam vs. electric parallels, in which, among other conclusions, Mr. Davis took the ground that "steam railroads will, in the near future, handle their suburban and short distance interurban passenger traffic and mail, express, baggage and light local freight carried in said suburban and interurban passenger trains by electric motive power; and this, irrespective of whether operating expenses are affected favorably or unfavorably." In this conclusion the writer firmly agrees, and proposes to show that to carry out this conclusion it is not even necessary to construct a parallel, but on the contrary, steam trains and electric cars can be safely operated upon one and the same track.

The writer (as manager of the Quebec Railway, Light & Power Company, part of which company was formerly the Quebec, Montmorency & Charlevoix Railway, a steam road operating between the city of Quebec and Ste. Anne de Beaupre and St. Joachim, a distance of 30 miles,) inaugurated a service of electric cars upon the same track and running between the usual steam railway service. The scheme was generally considered a bold one and one that would not meet with the success anticipated, the results, however, as will presently be shown, have more than justified the innovation and the expenditure incurred.

The Quebec, Montmorency & Charlevoix Railway, as it was formerly called, after leaving Quebec, passes along the flats comprising the north shore of the River St. Lawrence; for six miles there is a continuous row of farmers' and other dwellings running on both sides of the highway, which, however, is on the top of a cliff running parallel to the railway and at a distance varying from one half to one mile from the track; at Montmorency, the line runs through a small village, the inhabitants of which are mostly operatives in a large cotton factory, and from here the line runs through the following parishes:—L'Ange Gardien, population about 1400; Chateau Richer, population about 2000; Ste. Anne de Beaupre, population about 1500 and St. Joachim, population about 1000. Before the innovation of the electric system, this population were served in the winter by two daily steam trains leaving Quebec at 8.50 a.m. and 5.15 p.m. and leaving Ste. Anne de Beaupre at 7.15 a.m. and 11.40 a.m. In the summer by four daily steam trains, leaving Quebec at 7.30 a.m., 10 a.m., 5 p.m. and 6.15 p.m. and Ste. Anne at 5.45 a.m., 7.23 a.m., 11.50 a.m., and 4.10 p.m. There was also an additional steam train between Quebec and Montmorency, leaving Quebec at 2 p.m. and returning at 3 45 p.m. Special trains, as required, were also put in service to convey the large numbers of pilgrims visiting the Shrine of Ste. Anne.

The residents in the thickly inhabited portion on top of the cliff, between Quebec and Montmorency, previously mentioned, did not patronize the railway, but travelled by omnibuses, of which there were eight or ten.

In the year prior to the introduction of the electric cars, viz., 1899, the steam trains carried 253,054 passengers, including about 41,500 pilgrims to Ste. Anne de Beaupre. This did not appear to the writer to be satisfactory, especially during the winter, when residents would take advantage of the good winter roads and drive, rather than have the inconvenience of having to wait and be at a railway station at a certain fixed time to catch a train. As a result it was decided to electrically bond the existing track, put up an overhead trolley wire, high enough to allow of brakesmen travelling with safety on top of box and freight cars, put in an A. C., D. C. generator at the electric power station at Montmorency, and operate electric cars between the steam trains. These cars were each equipped with four 50 h. p. motors and Westinghouse air brakes, operated by an independent motor, and were so geared as to be capable of running at a speed of 45 miles an hour, standard railway car wheels being used.

The cost of this work for the 30 miles of track was as follows:

Electrically bonding existing track	$ 5,022
Overhead trolley, including poles, etc.	68,804
6 large double truck cars, seating capacity 54, with motors, etc., complete	51,606
One 600 K. W. A. C. D. C. generator and water wheel and one 200 k. w. rotary transformer at St. Anne, including switchboards, etc.	43,943
	$169,375

Upon its completion, in addition to the regular steam railway service, which was continued as before, cars were sent out between Quebec and Montmorency every hour between 6.30 a.m. and 9.30 p.m., and between Quebec and Ste. Anne de Beaupre about every three hours, and the following comparative statement shows the result of the year's operation in 1901, from which it will be noted that there was an increase of 218,320 passengers carried and an increased revenue of $29,071.39, with an increased expenditure of $5,698.46. From 30th June, 1901, to date, (12th June, 1902), there has been a further increase of 86,392 passengers over the corresponding period of last year.

Comparative Statement of Tickets Sold at Different Stations.

	1899 Steam		1901 Steam and Electric.	
	Passengers	Amount	Passengers	Amount
Quebec	108,103	$20,107.20	259,364	$33,976.70
" Pilgrims	41,329	7,687.35	106,280	13,922.34
Headleyville	2,431	452.30	4,759	623.45
Beauport	20,241	1,626.25	47,237	4,991.40
Montmorency	17,070	2,963.60	64,535	6,294.31
L'Ange Gardien	11,062	1,427.10	15,669	2,048.25
Chateau Richer	12,652	2,274.25	18,885	2,879.70
Ste. Anne	23 738	4,569.45	33,190	5,404.55
Beaupre	2 198	463.60	3,691	611.50
St. Joachim	2,920	563 00	10,557	1,596.62
Agencies	11,310	2,087.45	7,207	944.12
Totals	253,054	$44,221.55	571,374	$73,292.94

The operations for the year 1900 are omitted, as the work of electrifying the road was only partially completed.

The omnibuses previously referred to have been run out of business, notwithstanding the inconvenience of passengers having to walk up the cliff to get to the public road and their houses, and traffic has now so much increased that it has been found necessary to run cars every half hour between Quebec and Montmorency and about every hour between Quebec and St. Anne; and in addition the steam trains are run as formerly. On Sundays and holidays the resources of the Company are so fully taxed that it has been found necessary to increase the rolling stock with cars having a seating capacity for 120 passengers, and in addition to the regular cars, to run specials at from ten to fifteen minutes interval. It has also been found absolutely necessary to construct a double track between Quebec and Montmorency.

The writer, as an old steam railway engineer, would like very much to enlarge upon the subject of suburban railways and the desirability of steam railway managers studying and taking up the subject, but sufficient has, however, been said to show that it is advisable and in the interests of their companies to leave the old groove and not to allow other and independent street railways to compete for suburban traffic. It might perhaps be as well to mention that notwithstanding the traffic above mentioned, steam freight and special pilgrimage trains are being constantly handled and that no collision or any other accident has so far occurred.

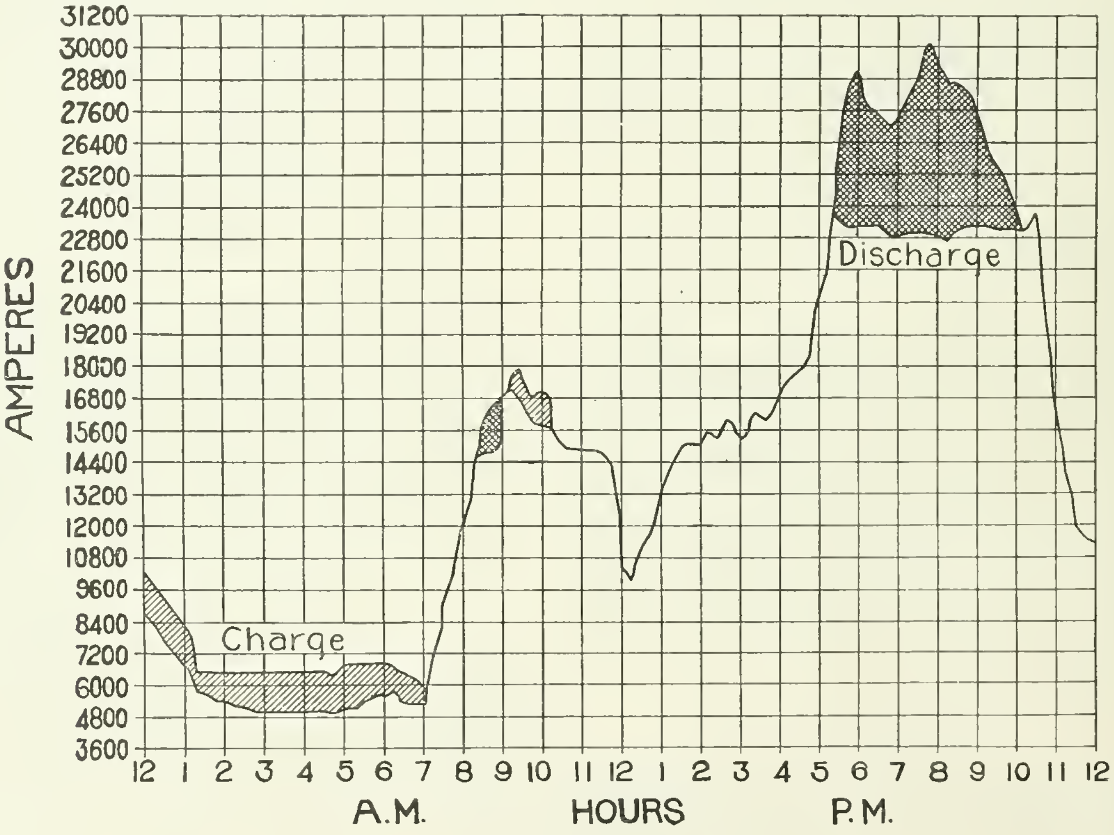
THE USE OF STORAGE BATTERIES IN ELECTRIC DISTRIBUTION SYSTEMS.

By A. A. Dion.

The writer's experience with storage batteries in the early years of their commercial application, when little was known as to their limitations and too much was expected of them, while it made him fully acquainted with their inherent defects, some of which have since been partly remedied, left a lasting impression on his mind of their valuable properties.

This impression was not generally shared by those engaged in electrical work at the time. Indeed, there was a prevalent prejudice in America against the storage battery, but this was generally most pronounced in those who knew the least about their behavior from actual observation. This prevailing antipathy, which found expression in loud denunciation and severe condemnation of the apparatus, could be traced to failures in their use which were mostly due to two general causes, namely, the employment of the batteries in services for which they were unfitted, and the weak mechanical construction of the cells first put on the market.

Nothing, perhaps, contributed so much to their bad reputation as the failures which followed their adaptation to city traction systems in the storage battery car. This service had been found too severe for the batteries as they were then made, just as the first electric motors employed in street railway work were found to be inadequate for good and reliable service. The batteries lacked mechanical strength, the forming processes were imperfect, proper adhesion of the active material to the supporting plates or grids was not secured, the importance of using a pure electrolyte was not well understood, and the results were unsatisfactory operation, rapid deterioration, and loss of capacity.



Curve 1.

So-called new types were constantly being evolved. Many and ingenious were the means employed to overcome the defects which had developed in practice. In reality all these devices were mere modifications in the design, mechanical construction, or manner of forming of two fundamental types, the "Planté" electrolytic cell and the "Faure" pasted cell, named after their inventors.

The work of Gaston Planté, which resulted in the secondary or storage battery, stands out in the history of electrical development as a shining example of exhaustive investigation. So thoroughly did he treat the subject of secondary generation of electric currents by means of the lead accumulator, that little was left for others to do in that line of work but to invent variations on the originals which he had established.

Later, other types were brought out, in which other substances than lead were used for plates, and electrolytes of various kinds were employed, but it is not within the scope of this paper to enter more fully into their description.

Then there came a consolidation in America of the various storage battery interests, and this led to a process of selection and elimination, from which was evolved a stronger and better battery than had been made before. A cell in which everything had not been sacrificed to weight, but one capable of meeting fully the requirements of commercial usage in those fields of application for which experience has shown the storage battery to be fitted. Then the range of application was narrowed, and the battery was not allowed to be sold for uses where failure might be expected, and thus was the previously unenviable reputation of the storage battery largely redeemed.

So many successful applications have since been made that the electrical engineer cannot now afford to ignore the storage battery as a factor in the design of electrical plants for railway, light or power supply.

It has been the general practice in designing electric light and power stations and in selecting the equipment most suitable for the work to be performed, to consider every type of generating apparatus and auxiliary devices, except the storage battery. When it was introduced it was generally an afterthought, or a means of overcoming a difficulty which had developed in the operation of a plant. As the storage battery factor has in many cases a distinct bearing on the capacity of the generating plant, much outlay and expense would often have been saved by providing for the battery in the first place as an integral part of the installation.

The writer does not claim that it is advisable to use batteries in all kinds of electric plants, or in any kind of plant, under all conditions, but the motive of this paper is to enter a plea for the due consideration of the storage battery as a possible factor influencing the design of electrical installations, with a view to their efficient, economical and uninterrupted operation.

One of the most serious drawbacks in the operation of electric supply stations is the inability to store the product, so that generating machinery must be installed of capacity sufficient to meet the largest demand, even if such demand only lasts a few hours, and is only made once a year.

One of the things most sought in operation is close voltage regulation, regardless of the amount and character of the load.

The storage battery provides the only known means of reducing the generating plant and ensuring its operation under best conditions for economy, by taking energy therefrom during the hours of light load and returning it to the circuit whenever the demand upon the station exceeds the capacity of the generators.

The storage battery ensures close regulation of voltage at the station, by keeping an even load on the generators and prime movers (whether engines or water wheels), thus maintaining generator losses constant and preventing fluctuations of speed. The voltage may also be maintained constant at the point of distribution by placing a battery there.

The storage battery also ensures uninterrupted service, as it permits of shutting down one or more units; either to make repairs or for economy in operation.

These advantages, which may be obtained by the judicious use of storage batteries, must appeal to all, but one must closely observe the behavior of batteries in practical operation to fully appreciate their value. Hence the writer would urge those who have not already done so, to visit and study some of the battery installations, of which many may be found in the United States, and a few in Canada, in operation under various conditions.

Storage batteries cannot be charged by alternating currents, therefore their use is confined to installations where direct current is available, but not necessarily only to plants generating or distributing direct currents exclusively. Thus, batteries may be used in connection with the following systems:

1. Direct current generation and distribution for light and power services.

2. Direct current generation and distribution for railway service.

3. Alternating current generation and transmission, and direct current distribution for railway service.

4. Alternating current generation and transmission, and direct current distribution for light and power services.

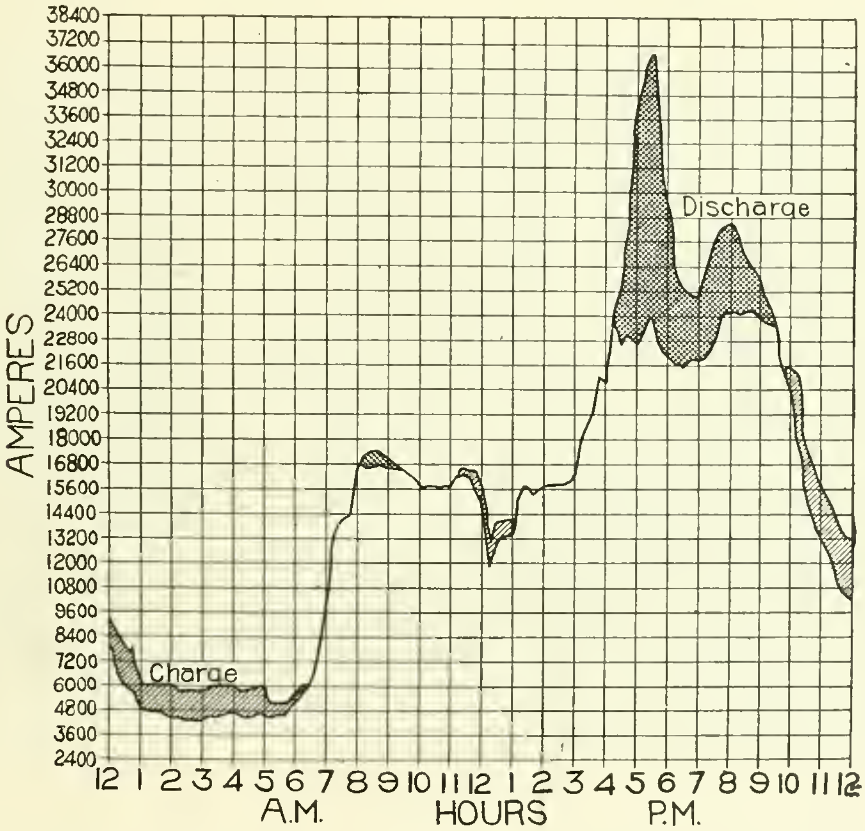
5. Alternating current generation and distribution for light and power services.

These systems can, of course, be mixed. There are plants in which two or more systems are combined.

Considering the application of batteries to each in turn, the mixing or combining of systems will not of course interfere with the usefulness of the batteries.

1. Direct Current Generation and Distribution for Light and Power Services.—Upon a system of this kind a battery can be installed at the power house where the current is distributed by the two or three wire method, or it can be located at a point out on the line near the centre of distribution. In many cases batteries are used at both places upon the same system.

The two curves which are marked 1 and 2, show the result of the operation upon a large station. On curve No. 1 the peak of the load is quite long, lasting for practically four hours. This peak rises to a maximum of 30,000 amperes, and of this amount the battery carries about 7,000 amperes, and the machinery is kept running from 5.30 p.m. until 11 o'clock p.m., at practically a constant load amounting to 23,000 amperes. The battery in this case receives its charge during the morning hours, from 12 o'clock midnight until 7 a.m. At this time the actual lighting load is not much more than 5,000 amperes. Curve 2 is of similar nature, except that the peak is somewhat different. There are in reality two peaks, one occurring at 5 o'clock, and one at 8 o'clock, separated by an interval of two hours. In this case the maximum rises to 36,000 amperes, and the battery absorbs the double peak, enabling the generator to run at practically the same load as shown on curve No. 1.



Curve 2.

The point brought to one's mind by these two curves is the fact that although the nature of the load may vary from day to day, the actual load falling upon the generator may be adjusted, so that it is practically the same each day, the battery taking the irregularities. This is of manifest importance, not only from a standpoint of efficiency, but of satisfactory and simple operation.

Curve 3 shows the effect of a battery operating at a sub-station. This curve shows the current absorbed and given out by the battery for twenty-four hours. The variations in this curve follow the changes in load at this point. Between 4 and 6 p.m. the battery is called upon for a maximum current of 30,000 amperes. There are also other short times in the day, one between 7 and 8 in the morning, one beween 1 and 2 in the afternoon, and one between 8 and 9 at night, during which the battery discharges.

The result of such operation is not only to relieve the main station, but also to reduce the copper investment or copper loss, and the removal of the fluctuations of voltage due to the varying drop in the conductors, caused by fluctuating loads.

In most of the large Edison systems in the United States now using batteries, the cells are arranged with several end cell switches, which enable feeders to be tapped in at various points upon the battery, thus obtaining feeders of varying pressures. This is of great importance in handling distribution over wide areas. Upon very large systems, such as are represented by the curves shown, the load during light hours is of such magnitude that it is not practicable to shut down the generating stations, and in such cases the batteries are very seldom used for this load. Upon smaller systems, however, this feature is of great importance, and it is usual to shut down the station say from 11 or 12 o'clock at night until the following morning. In one small plant not only was the battery utilized in this way from midnight until morning, but during this time the plant was locked up, and the battery carried the load without attendance.

When a battery is installed at the power house, it is not necessary to adopt the old system of using two generators in series for the three-wire system, since the neutral can be taken to the middle part of the battery and the battery used to take the unbalanced portion of the load.

2. Direct Current Generation and Distribution for Railway Service.—It is evident that the same advantages which obtain from the use of batteries in general light and power service will apply here. The charge and discharge

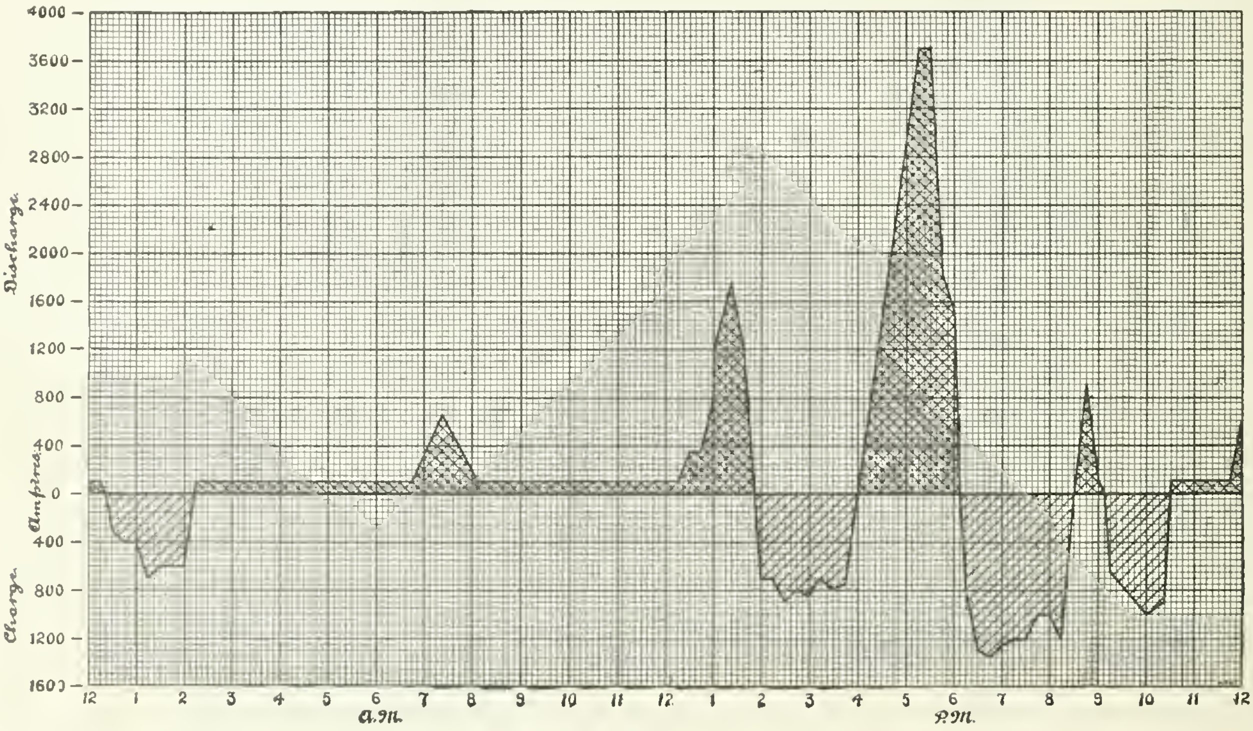
curve, however, will be very different, as the peaks of the railway load will occur every few seconds. The generators may be made to carry all day substantially an even load, much under the maximum demand, and the regulation will be wonderfully improved, especially if batteries are placed at one or more points on the line.

3 Alternating Current Generation and Transmission and Direct Current Distribution for Railway Service.—In such systems (whether combined with D.C. lighting or not) the alternating current is usually received from a distance and distributed from rotary sub-stations. From the D.C. end of the rotary the distribution is similar to the cases cited above. It therefore follows that batteries fulfil the same general requirements as before, and the battery may be installed in the rotary sub-station in parallel with the direct current end of the rotary, or it may be placed out upon the line. The advantages arising from such installations are the same as discussed above. In this case it has the additional advantage of reducing the number and size of the rotaries, and as an emergency reserve the battery has still greater advantages on account of the added risk of breakdown on the A.C. transmission lines. In most cases the energy is derived from water power, and the battery not only takes care of the fluctuations in the load, but also of the variations in the A.C. power available.

4. Alternating Current Generation and Transmission and Direct Current Distribution for Light and Power Services.—The behavior and advantages of the battery in such cases are fully described under the preceding headings. If you will imagine that the loads represented by curves No. 1 and 2, instead of being taken from central stations, were taken from the D.C. end of rotary sub-stations, these would then represent very nicely the effect of batteries operating in rotary sub-stations supplying light, or light and power.

5 Alternating Current Generation and Distribution for Light and Power Services.—Since the storage battery is of necessity a direct current appliance, it is, of course, impossible to install it directly in parallel with alternating current machinery, and where the entire system, both of generation and distribution, is of this character, it is necessary to install in connection with the battery a motor-generator or rotary, charging the battery and discharging it through the direct current end. On charge the alternating current end of the rotary will act as a motor, and on discharge, it will act as a generator in parallel with the alternating current system. The battery and rotary can be placed in the main station or at points out on the line near centres of distribution. The objection to this method is that the rotary must be of very large size, that is, it must carry the entire ouput of the battery when it is discharging at its maximum rate.

The writer does not know of any place where such a system was ever installed for the above purpose, but rotaries with batteries in parallel used for D.C. distribution have been employed in certain emergencies to assist in carrying the A.C. load.



Curve 3.

But we have not considered the case of stations which generate alternating currents only, or sub-stations receiving alternating currents only, from a distance, which distribute alternating currents for light and power, but where it is found necessary to operate rotaries for railway service, elevator power service, or to supply D.C. motors installed under a D.C. generating plant, which has been displaced by A.C. apparatus. In any of these three cases the fluctuations of D.C. load must not be allowed to impair the voltage regulation on, say, the A.C. lighting feeders. The storage battery if placed in parallel with the D.C. end of the rotaries may be made to absorb the fluctuations of load, and enable the rotaries to run steadily under practically constant load, thus improving the regulation on both the D.C. and A.C. systems of distribution. At certain seasons the peak of the A.C. lighting load may come at a time when the D.C. load is light; in such a case the battery would be made to run the rotary as a D.C. motor, causing it to generate A.C. currents in parallel with the A.C. generators, relieving these of part of the station load.

Curves 4a and 4b, taken from a plant in this councountry such as has just been described, show the improvement in the voltage regulation on the A.C. incandescent lighting circuits, following the installation of a storage battery in parallel with the D.C. end of a rotary carrying a street railway load, said rotary being supplied with alternating currents from the same busses as the incandescent lighting circuits. The E.M.F., which previously varied 10 to 15 volts, now varies only 2 to 3 volts. Had a battery not been installed in this case, power for operating the railway would have had to be obtained from some other source, or a separate transmission line would have had to be built from the power house.

Some three years ago the writer installed a battery in Ottawa in multiple with D.C. generators, operating at 250 and 500 volts, on a three-wire system. The battery was placed at the centre of distribution about one and a half miles from the station. Owing to bad speed regulation of water wheels and a varying load of D.C. motors, including many direct connected elevators, it had been found impossible to obtain regulation which would be satisfactory to many of our customers. Complaints were both loud and deep for a time, until the battery was put in service. Although this battery was operated wihout booster or regulating device of any kind, the improvement in regulation was such as to silence all complaints and to elicit complimentary remarks from many of our customers.

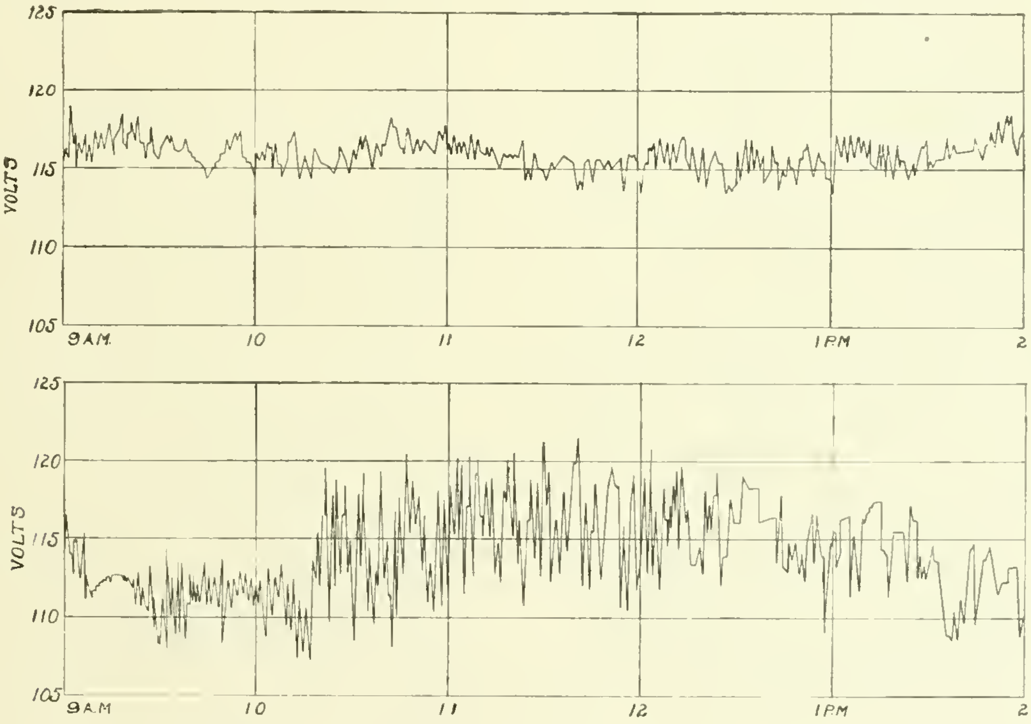
The writer has endeavored to set forth briefly and in a very general manner the principal advantages to be derived by using storage batteries in various kinds of installations.

Two more points might be considered with special reference to the driving end of the plants, in one case a water power, in the other a steam power station.

It is often the case in water power plants that power is rented at so much a year. When this power is used for lighting or railway work, in which there are heavy peaks of short duration, it is evident that the yearly rental will be the price of the power necessary to take the highest peak of the load. In these cases a battery is used to cut off this peak, thereby lowering the rental of the water power. The size of the battery will depend upon the interest and depreciation on the battery investment compared to the cost of rental per K.W., together with the interest and depreciation on the cost of the generating capacity that the battery displaces. In the same manner, when a railway load is of a very fluctuating nature, the cost of average power will increase on account of the fact that although the average of the fluctuations is the same as the average load when there are no fluctuations, the rotary machinery works at a very low efficiency on a low load factor, and in that manner the average power required increases.

In steam driven apparatus, to bring out more fully the advantages of a battery displacing apparatus on a peak, let us imagine we have a two-hour peak; it means that the machinery to run this peak will only be operating 730 hours during the year, and will have to earn during these hours the interest and depreciation on the investment, together with the cost of operation. This is clearly impossible, and besides the benefits, accruing from the use of a battery, of improved load factor and better regulation, the saving in first cost of this apparatus must be taken into account.

The rather high first cost of storage batteries makes the question of their profitable employment sometimes difficult to solve in their favor, but as illustrated in the cases just cited, it is a matter of calculation, not a difficult problem, if you know the cost of producing power, also the rate of depreciation on the batteries and cost of maintenance, which together should not exceed ten per cent. per year.



Curves 4a and 4b.

It is not the purpose of the writer to enter into any calculation at this time, nor to advise the use of batteries indiscriminately, but merely, as stated before, to urge the members of this Association to fully inform themselves as to storage batteries, consider well their advantages, and reckon with them when designing new plants or additions to old ones.

THE ELECTRICAL EQUIPMENT OF AN ORDINARY STREET CAR.

By A. B. Lambe, Jr.

Electric railways, as we are all aware, are fast becoming more numerous throughout the world. Perhaps England is making the greatest strides to-day, though still far behind this continent in the number and value of the roads in operation; this progress being such that from the double reduction rheostatically controlled 5 to 6 ton car which was the very latest and best product of but a few years back, we have come to now consider a 125 ton train, the units weighing 25 to 35 tons each, with some one of the various forms of master control now on the market, or a single locomotive, such as those of the Baltimore and Ohio Railroad—not an uncommon sight. Equally to be admired are the many forms of smaller equipments which are used to-day in large numbers, such as the various industrial railways in service the country over, for mining, telpherage, factory transportation, private shunting, in fact there to-day remains practically no form of travelling or conveying mechanism or apparatus which does not find its most advanced exponents using electricity to a very great extent, in some cases almost exclusively. By this we do not mean to say that electrical machinery is going to supersede all other forms of power transforming apparatus, or that it is the panacea for every difficulty, for we are all ready to acknowledge that compressed air, rope, belt and chain driving, and the steam engine have each their field which cannot be commercially invaded by the electric motor, but, on the other hand, electrical machinery has made fields for itself, and in doing so has been a factor in the world's increase of wealth to an extent which a few years ago was not dreamed of. Chief among these is the work of traction in its many and varied forms, and presumably it is to heavy electric railroading that we must look for the greatest field of the large output of the future, which we all trust will be a feature of the years to come.

A text such as this would occupy us for a long time, if discussed only in its generalities, and therefore we must confine ourselves to the subject matter proper, and as all that is to be laid before you will be of a strictly elementary character, it has been decided to illustrate it with samples of the various apparatus which go to make up the motive and controlling power of the ordinary car with which we are all so familiar, even if only through the fare-box; presumably the logical way of handling the matter will be to divide the equipment into its main features, and discuss them one by one, the trolley, controller, rheostats, motors, etc.

The first roads put into service used two trolley wires and two trolleys on the car, or, as it is now called, were of the double trolley type; we can all picture the difficulties encountered in such a form of construction as this where there were turnouts, crossovers and crossings to insulate; it has to-day been almost universally abandoned, the rail being used as a conductor instead of one of the wires, though occasional survivors are found. The trolley wire was round, and though soft at first was soon made somewhat harder than that used for ordinary purposes, being suspended in nearly all cases by mechanical clips, which had the great disadvantage of being in the way of the trolley wheel; the result was a heavy blow every time the wheel went under the clip. Efforts to overcome this difficulty led to the various designs of the soldered ear, the wrought sheet hanger, the Walker clip, and the figure 8 wire, an ever-improving chain leading finally to the evolution of the grooved wire, which is to-day considered the best trolley wire equipment to be found in the market. In passing we should note that a wire of any given size has the same resistance, weight, etc., length for length, irrespective of whether it is round, figure 8, or grooved.

The soldered ear in connection with a round wire is also used extensively, but its grip is not as good as that of the mechanical clips which are used with the grooved type, and it is much more expensive to put on or take off.

The almost universal trolley wheel of this country for city work at moderate speeds, 4 to 5 inches in diameter, has reached a point where it might be considered standard. It is usually made of brass, though occasionally with iron with a brass center, to avoid undue wearing of the wire. It has a separate piece bushing, which can be renewed cheaply, a steel spindle automatically lubricated by oil or graphite, and is carried by a malleable iron harp, designed to as much as possible prevent catching in the overhead work. There are of course numerous styles and sizes of what might be termed freak wheels running up to as much as 10 inches in diameter, for high speed duty 6 inches is a common size. There is also the sleet cutter, used in localities troubled with storms in cold weather to clear the trolley wire of the accumulated ice and snow.

Under the heading of trolleys, we should mention—we have not time to go into them in detail—such other current collecting devices as the third rail, the conduit systems, and, as a curiosity, the roller trolley. This latter is used quite extensively to-day on the Continent, though it has never made any great progress in this country; it was exploited to a certain extent by the old Walker Company. The pressure of the wheel against the trolley wire is somewhere about 20 to 40 pounds, which, after the addition of the pressure or strain necessary to balance the weight of the wheel harp and pole, means a tremendous strain on the trolley stand and the superstructure of the car; few realize how large it is. When horse cars were first changed over to electric propulsion, this great roof strain was not recognized, and the cars soon presented badly distorted roofs; modern practice provides a long and heavy wooden trolley stand on which is mounted the metal base, thus distributing the stresses uniformly over the roof. The trolley poles to-day are all steel, usually seamless and graduated in thickness and diameter from top to bottom, sometimes reinforced near the stand; the first equipment was wood, with a wire run down the side to carry the current. The latest types of stand being brought out to-day are low, provided with ball bearings, and arranged so that the pressure on the trolley wire is approximately uniform, no matter what the height of the pole; it will be readily recognized that this latter feature is a valuable improvement. The latest addition to the standard car equipment is the trolley catcher, of which there are two broad types, those which prevent the wheel, when it comes off the wire, going more than 6 or 8 inches above it, and the style which not only does this but in addition immediately pulls it some 15 or 18 inches below, rendering its catching in the overhead structure a remote possibility.

The next device through which the current passes is the protector or fuse, provided for two purposes, first, to protect the system against any fault in the car equipment, which would otherwise amount to a short circuit, shutting down the complete road, or at any rate part of it, and secondly, to protect the motors from too much current, whether caused by too many passengers or too many trailers, or, as is much more frequent, by improper handling of the controller. The original equipment was a plain ordinary fuse box usually placed under the platform, but since the replacing of a fuse was a dirty and tedious proceeding, there was introduced the double throw fuse box mounted in the hood. If one fuse blew there was another already in place to which to turn; all that was necessary was to throw the handle over. Contemporaneous with this was the magnetic blowout fuse box, with which we are all familiar. All the foregoing were first-class in their day, but have been gradually superseded by the circuit breaker, which stands to-day as the standard car fusing or safety device of modern practice.

If the car is provided with an ammeter it is usual to insert it next in the circuit. Such an instrument is a somewhat unusual equipment except on the heavier cars used for high speed work.

The current goes now to the controller, the case placed on the car platform, and which, actuated by the motorman, makes the **car go fast**, or slow, or stop, according to the position in which the handle is placed. Just as the ordinary constant speed stationary motor is started to-day by the insertion of resistance in series with its armature, so the first railway motors were controlled in a similar manner, the Thomson-Houston type with the operating handles on the platform controlling through wire cables a semi-circular rheostat, placed under the car; the equipment being sometimes known as the "stemwinder" is perhaps the most widely known of this type. Recognizing the wastefulness of this method, especially where a motor, as is the case in railway work, has to be run so much of its time at less than full speed, there was brought out the Edison drum controller, which was more economical in that it altered the speed partly by the use of a rheostat, and partly by varying the field strength by connecting the coils composing the field, of which there were several, into various combinations of series and multiple. This was a great improvement in another direction also, as it brought the working parts up on the platform where they could be easily inspected, the Westinghouse Company bringing out a somewhat similar type, in which the growing duty imposed upon street railway apparatus was recognized by making the working parts heavier and more substantial. After these came the type which, in combination with a rheostat, put the motors in series or in multiple, as desired, whence the name series-parallel, this idea being the principle underlying all the various types of present day apparatus, the economy in power consumption over a pure rheostatic control being so marked that nobody to-day would entertain the latter for a minute; the main principles governing its operation can be outlined as follows:

The variable speeds necessary during the day's operation of a car can be obtained, assuming that the load is kept constant, only by varying the voltage impressed upon the motors. This variable voltage can be produced either by inserting resistance in series with the two motors connected in parallel, or by connecting the two motors themselves in series, in the latter case one can be said to act as a resistance for the other, each running at approximately half speed and producing a counter E.M.F. of 250 volts, the two added together balancing the impressed or line voltage of 500. When connected in this way the current goes through one motor and then, instead of through a wasteful resistance (in which case you would need another current of equal amount to operate the other motor), the same current goes on through the second motor and in so doing produces useful motion. The result of this is that with the motors in series the current and consequently the power consumption is just half what it would be if the same reduced speed were obtained by means of resistance. Further, if the voltage delivered to each motor be changed abruptly from 0 to 250, and from there to 500, without any intermediate graduations, the speed of the car would be correspondingly jerky, and so it is found necessary to insert rheostats, but for a short time only, in circuit with the machines, both when first put into series and also when first thrown into parallel; these, however, are almost immediately cut out, in 3 or 4 steps, and thus a gradual acceleration is obtained. We thus see that the series-parallel controller, of whatever type, is a piece of apparatus, a combination of switches, which are arranged so that the rotation of the drum first connects the two motors in series with each other and a rheostat, by further rotation of the cylinder this latter being gradually cut out until the motors only are left; next they are connected in parallel with each other, the rheostats being again inserted to prevent the sudden rush of current and the corresponding increase of speed which would otherwise result; again the rheostats are cut out, leaving the motors alone but now in parallel. The first step of the controller gives the slowest car speed available, the current consumption of the car being the same as that in each of the motors, seeing that the same current goes first through one and then through the other; the last step of the controller gives the highest speed, the car now consuming twice the current in each motor, seeing that two entirely separate and approximately equal currents are passing through each machine.

This type of apparatus, irrespective of the manufacturer whose name it bears, presents the same general features. The reversing switches, one for each motor, are contained in the same case as the main cylinder (in the first equipments they were separate, being mounted under the platform), and are mechanically interlocked with the main cylinder, so that they cannot be operated unless the latter is in the off position, nor in turn can this be moved if the reverse cylinder be in its center or off position. The first interlock is provided for two reasons, namely, that it is highly undesirable, both on account of its effects on the motors and on the line, that a man should have the power to suddenly reverse a car without having to first throw off the current, and again, the reversing switch being built with but small clearances between the various parts and practically no arc disrupting power, if opened with current on would probably be destroyed by the resultant arc. The second interlock provides a quick means of noting the position of the main cylinder, and also of insuring that, in the absence of the reversing handle, the car cannot be moved either accidentally or by interference. Switches are provided for cutting out each motor, obviously a great improvement over the original method of disconnecting the car wiring, at the point where it entered the motor, by means of a screwdriver. When the controller is built so that these switches replace the machine which has been cut out, by closing the circuit, they also interlock with the main cylinder, so as to prevent the latter going beyond the series steps, when they simply cut out the offending machine and leave open the circuit in which it was formerly connected; no interlock exists and the car takes no current, and consequently does not move until the main cylinder is turned to the parallel steps. The remaining feature worthy of note is the arc disrupting device which is provided on the main cylinder of practically all series-parallel equipments, the magnetic blowout. It will readily be recognized that the work of a controller, especially on a city road where it is in almost constant use, is something tremendous, and that the effect of the arcs, if not broken as quickly as they are by this device, would lessen the life of the wearing parts in a very marked degree, or conversely, to get the same life you would have to build a much larger and therefore much more costly piece of apparatus. In fact the present spacing of the fingers, without the blowout feature, would not break the arc at all, and almost every time you turned the cylinder off, if carrying a current approaching the full load of the motors, you would get a short circuit.

Controllers are built to handle both two and four motor equipments; the two types do not differ to any great extent, it being usual, in four motor cars, to connect two machines permanently together, usually in parallel, and consider them as one machine; the other being treated similarly, the controller taking these two groups as if they were two motors only, instead of two units each consisting of two motors, and putting them in series or in parallel as desired. The main difference between a two and a four motor controller, apart from the fact that the latter is larger and heavier in its conducting parts, is in the reversing switch, which has two sets of fingers for two motors, and four for four motors. It is essential that there be a complete reversing switch for each and every motor on the car; if not, the result will be extremely unequal field strengths, or, in other words, the work of driving the car, instead of being performed by each motor doing its own share, is left nearly all to one.

Tests have shown motor currents of 60—30, 80—20, 90—10, 125—15 amperes respectively on the machines of a two motor equipment, and on four motors 90—40—20—5. The same car when equipped with a proper four motor controller, the motors, rheostats, loads, etc., being unchanged, gave readings of identically the same value on all motors, namely, 20 amperes.

The weakened field system of speed control, obtained either by cutting out some turns of the field wire, or by shunting part of the field current through a resistance, used originally with the Thomson-Houston rheostatic system, was continued when the series-parallel equipment was first introduced, but has been discarded by later practice. It was found to be more or less of a complication, especially when used in connection with multipolar machines, whose use was not warranted by the results obtained.

Roads operating high speed four motor equipments frequently find it necessary, or at any rate desirable, to be able to reduce the maximum possible speed of their equipments without being compelled to keep the rheostats constantly in circuit, examples being cases where municipal ordinances require slow speeds within their limits, or where exigencies of the service demand that equipments normally arranged for high speeds be available for shunting. This condition is conveniently met by the addition to the standard controller equipment of what is called a commutating switch, a piece of apparatus which, distinct from the controller which it accompanies, performs the function of connecting the two motors composing each group in series for slow speeds, shunting, or heavy haulage, in parallel for normal operation at high speeds. With this switch set in the series position, all four machines will be in series on the series steps of the main cylinder (A), when the latter is turned to the parallel position two motors in series are put in parallel with two in series (B), with the commutating switch set for parallel connection the combinations become respectively two in parallel in series with two in parallel (C), and all four in parallel (D). Assuming the line voltage and car weight to be unchanged, A gives the least power consumption and the slowest speed, D requires most current and produces the highest speed, B and C are identical in their results. An exception to the foregoing might be noted in those cases where locomotives, normally designed for large tractive power at slow speeds, are sometimes required to develop higher speeds when running light, in which event the series connection is the normal position of the commutating switch, it being turned to parallel only when the more or less infrequent call comes for high speed. This switch not being intended for operation when the car is in operation, is not provided with any provision for extinguishing the arc; if opened with current on the motors it would probably be destroyed.

There are several interesting peculiarities in connection with the series-parallel method of control, the reasons for which are not always apparent. One is that of wheel slipping, which is especially troublesome with single truck cars. If one of a pair of wheels start to slip, the motor in series, it will be seen that it is almost impossible to get reasonable traction from the car as long as the motors remain connected in this manner, because that motor which is running comparatively fast, due to its consequent high counter E.M.F., takes but little current. This in turn means that the other machine, being actuated by the same current, has but a small torque due to the little current flowing, and the grip of the slipping wheels being practically nil, the total tractive power of the car is but small. On the other hand, if the motors were in parallel, the one not slipping, due to its slow speed and consequent low counter E.M.F., would take a large current and therefore have that much more tractive power. Wheel slippage is much more common on single than on double truck cars, because in the former it is comparatively easy to unbalance the distribution of weight, in the latter the relative length of the car past the trucks, or the overhang, as it is called, is much less, and consequently the position of the passengers has less influence. On the other hand, a single truck car, with the modern long rear platform, is frequently loaded down so as to take quite a large amount of weight off the front wheels; again, at starting, which is the time slipping is felt, the truck tends to go forward and the body to stay behind, the result is a tilting action also tending to decrease the weight on the front wheels. For this reason, and also because dirt or snow is encountered first by the front wheels and the rail more or less cleaned by them before the rear pair pass, single truck cars, when on straight track, usually slip most in the front wheels. On the other hand, when on curves the front flanges grip on the sides of the rail head, and also on the lip if a grooved section be used, the trailing pair riding comparatively free, so that the condition is reversed, the rear wheels being more likely to slip.

Another peculiar point is that, under a certain condition of trouble with the wiring or controller, a car which normally gathers speed with each successive step of the controller, runs faster on some of the series or lower speed steps than on the first one or two of the parallel positions, this condition being that of a ground on the wiring of No. 1 motor between the point of its leaving the machine and entering the controller, and which, until the motors are not in series, virtually short circuits machine No. 2; consequently the latter is not in circuit until the controller is turned to the parallel position.

The foregoing applies to individual controllers, one or two per car, manually operated, the multiple unit or master control system involves various special features; it is not possible in the scope of this paper to do more than enumerate the broad principle, which is as follows:

Each car equipped for master control has mounted upon it its own motors, two or four in number, a main controller to handle them, a set of bus wires, extending from end to end of the car and connectable to those of the next car, for moving this controller, and one or two master controllers for energizing these bus wires. From the foregoing it follows that when the bus wires of two or more coupled cars are connected they can be energized throughout the whole length of the train, from any one master controller desired. When this is done, current having been turned on to these bus wires from some one of the master controllers, all the various main controllers move, and obviously simultaneously, assuming different positions according to which of these bus wires be energized, and in doing so they in turn connect the motors into series or parallel, similarly to the hand operated apparatus. It will thus be seen that any number of motors, mounted on various cars, can be simultaneously varied in speed by the operation of any one small master controller.

There are three systems now on the market, the Sprague, Westinghouse, and General Electric. The Sprague Company use a main controller, modelled somewhat after those built for hand operation, replacing the motorman's handle by a small motor. The Westinghouse Company use an air cylinder, with a pinion and rack, in place of this small motor, controlling the admission of air to the cylinder, and thus the movement of the piston, by electrically operated valves. The General Electric Company divide the main controller into a number of separate switches, consisting of a movable arm, on the end of which is mounted a contact, this arm being actuated by a solenoid supplied with current from the bus wires.

The question of brakes does not properly enter into the electric equipment of a car, except those which are electrically operated, though it is interesting to note the various styles and classes which have become more or less standard. There are in use to-day three main types, the manual, mechanical, and electrical. The greater part of the equipments in ordinary city work belong to the first division, being equipped with spring or gravity release, and occasionally being reinforced with the safety device of a plunger arranged to act as a block behind the rear wheels, used only on systems running over numerous heavy grades on which stops have to be made. In the mechanical class are grouped those types whose breaking mechanisms are actuated by the motion or momentum of the car through the medium of a clutch mounted on one of the axles. The air system would also come under this head; there are two distinct methods, one in which the car reservoirs, comparatively small, are charged from a motor and pump carried on the car itself, and the storage system, in which the cars are replenished from a common pump situated at some convenient point on the line, in which event the car storage tank is relatively larger. The electric types operate either by friction discs, one revolving with the axle and the other mounted on the motor, or by a solenoid pulling a plunger on to the rail head and at the same time, through a suitable system of cams and levers, setting the shoes on the wheels in the ordinary manner. In both types the current, which is obtained by operating the motors as generators, is controlled by the main cylinder, which is then provided with additional steps and turns backward from the off position. There is also the emergency electric brake, which, while not commercial, may occasionally be of great service, it will be discussed later.

The lighting of practically all our modern cars is by means of incandescent lamps, and presents no special features; they should in all cases be equipped with reflectors, whether mounted in groups or singly. Cars built lately are usually equipped with either bullseyes or illuminated signs to indicate the route to which they belong; these are furnished with light by either a series of lamps of their own, or else by some of those which also light the car.

It is now usual in the case of double-ended cars to arrange the headlight so that when one is in use the vestibule light on that platform is extinguished, and vice versa; this is accomplished ether by means of a removable headlight, in which case the action is automatic, the transferring of the lamp itself accomplishing the switching; or else if the headlights are stationary, one on each end, switches are used to light either them or the vestibule lamp as desired.

The headlight most frequently consists of an incandescent lamp, mounted inside a weatherproof case, which also contains a reflector, more or less efficient according to the money put into it, though very frequently, especially for interurban work, where cars are run at a fairly high speed and therefore require a somewhat greater length of road in which to stop, arc lamps are used for this purpose. Being on a 500 volt circuit, they require a rheostat in series, sometimes the incandescents in the inside of the car are used for this purpose, though it is more usual to employ a dead resistance. In the more temperate climates this is occasionally used as part of the car heating system, being mounted under the seats and arranged with radiating facilities, so that the hot air coming from them assists in warming the car. Occasionally the cars are equipped with arc lamps for inside lighting as well as for the headlight, in which case they are all run in series.

On those systems which require artificial heating of the cars, the method by which it is to be accomplished is a very moot point, coal, hot water and electric all being available, the advantages, from the passenger's point of view, being all with the latter; there is also much to be said in its favor from the operator's standpoint. In the first place it is absolutely clean as compared with any form of stove, there being no ash to cause dust, nor fuel of any sort to carry along with the car; if properly built they present no source of fire risk; they give off no noxious fumes, ready for instant service they do not occupy the conductor's attention which might profitably be employed elsewhere, and if properly arranged they distribute the heat all along the car in the place where it is most needed, namely, near the floor. On the other hand, any form of coal stove placed in the car body is notoriously deficient on all of the above points, scratching the frame when being taken in and out, a source of dust and dirt, it is unanimously voted a nuisance by everybody; the only thing to be said in favor of any of the various forms of heating, opposed to electric, is that they are cheaper. Roughly speaking, it costs something like seven times as much to heat a car electrically as it does by coal, or to put the matter in another way, seeing that the average horse power consumption of an ordinary city car will be somewhere in the neighborhood of 20 h.p. per hour, and that of the heaters 5 to 10, it will at once be recognized that if the cars are to be heated electrically that the generating equipment, with the engines and boilers or water wheels to operate it, must be materially increased over that necessary for the work of propelling alone. It is usual in electric heating to provide means for varying the temperature and correspondingly the current consumed, by dividing the heaters into sections and connecting these in various combinations of series or parallel.

The rheostats of modern equipments are usually built of some form of iron resistance, coiled iron wire, iron ribbon, or cast iron girds, the latter being the latest form. They are required to dissipate considerable energy in the form of heat, and therefore have to be kept more or less away from the car body, usually bing mounted on insulated supports to the under side of the framework where they can be got at for inspection, and still not be in the way of water and dirt from the wheels and street.

The usual equipment is not designed to remain in circuit for any appreciable period longer than that necessary to start the car, which is the reason for marking only certain of the controller steps as running positions; if the cylinder be left too long on those which have the whole or part of the rheostats in circuit, they are likely to be damaged. Commercial requirements, which are the limiting features of all apparatus, seldom call for continuous running on any of the rheostatic steps; if desired it is only a matter of money to put in sufficient capacity to be able to do so. In locomotive work, where shunting at slow speeds is a necessity, the rheostats are made much larger, the equipment for a pair of motors used for this class of work being in some cases as much as four to five times as large as that necessary to control it for ordinary traction duties.

We next come to the consideration of the motors themselves, they constitute that part of the equipment in which the electrical energy, conveyed from the stationary trolley wire to the moving car by means of the trolley pole, is converted into mechanical power, the machine which forms the actual source of motion of the car. The electric motor, as we have so often been told, was more or less accidentally brought to light; it being discovered that an ordinary dynamo if supplied with current would rotate and deliver mechanical power from its shaft; similarly the first street railway motors were dynamos, are machines it is generally reported, coupled to the axle by means of belting or chains; these were soon followed by machines designed for this particular work, the first types being bi-polar, with high speed armatures and double reduction gearing (two pinions and two gears), the electrical parts being absolutely unprotected from the weather. The motors of to-day, irrespective of their makers, all have the same general features; four poles, two sets of brushes, single reduction enclosed gears running in grease, and a practically water-tight cast steel motor case, usually parted horizontally. Between the first more or less experimental forms and the machines now standard there were a tremendous variety of ideas and forms brought out; it is impossible to go into details here, though it will be of interest to touch on the main features.

The first gears, as above, were double reduction, that is, there were two pinions driving two gears, made of rawhide, brass and steel; cast iron also was used; to-day cast steel for gears and hammered iron or steel for pinions is the usual standard. It was soon found that the open gears wore very rapidly on account of the dust and dirt which they encountered, and therefore with the introduction of the single reduction type came the gear case; this at first was of sheet copper with a cast brass frame rivetted and soldered together, passing in turn through an number of stages to cast iron, malleable iron and pressed sheet steel; experiments are now being made on a type composed of a canvas cover on a brass frame with a spring sheet steel lining on the lower half.

Both ring and drum windings have been used for the armature, made sometimes with round wires and again with those of oblong section, the coils wound on to the body by hand, or again being machine formed before winding. For the commutator cast brass and cast and wrought copper have all been tried; to-day standard construction uses machine wound coils, drum windings and wrought copper bars equipped with carbon brushes.

The first machines were bi-polar, and when it was found desirable to cut out one set of gearing there came the consequent struggle to reduce the armature speeds; the most obvious method was to increase the number of fields from two to four, and a number of forms were brought out for that purpose. The first types had two consequent and two salient poles; if arranged with the former horizontal, they made the depth of the motor too great, seeing that the standard 33-inch wheel allows but little room to keep clear of the roadbed; if placed vertically the machine could not be parted along the horizontal plane, which latter was an extremely desirable feature. Finally their came the four pole salient type arranged with the poles set 45 degrees from the vertical, which allows convenient horizontal parting and is the form which has been adopted by practically all manufacturers.

Practically nothing but cast steel, or some one of its nearly allied compositions, has been used for the motor frame proper. The original machines were entirely open, and the first attempt at protection from water and dust was a pan placed underneath and partially up the sides of the machine; then canvas was hung down from the car body; next the frame itself was extended so as to afford more protection to the parts inside, and finally it was made in two bowl shaped halves, completely enclosing the armature and fields, which is the style standard to-day for moderate sized machines of all makers. The field poles are cast as part of the frame, or sometimes cast steel machined separately and bolted to place; again there is the laminated type, either with the frame cast round them or held in position by bolts, as compared with the solid pole this construction produces a lighter machine for a given output, and one somewhat more efficient: In this totally enclosed type of case the ventilation is practically nil; on elevated systems and in some interurban roads advantage is taken of the comparative absence of dust and dampness to put openings in the frames which, partially closed by screens, allow more or less air to circulate through the windings.

The lubrication of all moderate size motors is by means of grease, held in pockets cast in the frame over the bearings: these latter are generally outside the machine proper, being provided with channels underneath so that any overflow or drippings are thrown outside, lubricants of all descriptions being fatal to good insulation. Occasionally there is provided an auxiliary oiling wick underneath the bearing, the grease then being more or less of a reserve intended to be used only if the journal gets hot, in which event it melts and thus provides extra lubrication. On the heavier motors for elevated work, oil is depended upon almost entirely, though it has the disadvantage of causing much more drip than the greases.

The foregoing covers the general outline of the standard moderate sized street railway motor of to-day, there naturally are many modifications, such as the type in which the frame instead of being split horizontally, is cast in one piece, cylindrical in form, the armature and fields being removed through openings in the ends, normally filled by cast iron shields carrying the bearings; there is also the gearless motor, a type which has found much more favor on the Continent than it has over here, though it should be noted that the Baltimore and Ohio locomotives, the largest electric traction machines ever built, weighing nearly 100 tons each, are of this type.

Equally a curiosity, at any rate on this continent, is the alternating traction motor ,though it has been used to some extent in Europe; those built over here follow to a great extent the general lines of the D.C. machines, except of course in their internal arrangements. It should be observed that they can be run in series parallel, the armature of one machine supplying the fields of the next, somewhat similarly to the standard series parallel controller.

All street railway motors to-day are series wound, that is, the same current after passing through the armature goes on through the field coils, or vice versa. Shunt machines are unsuitable for several reasons, one is that being essentially constant speed apparatus they would tend to drive the car at the same rate irrespective of the load or the grade. In climbing hills this would result in a greater current consumption than the motors could stand, on the other hand the series motor slows down with an increase in load, and consequently takes less current than would be needed if the same speed were maintained.

The field coils are sometimes connected in front of the armature, in which case they are said to act as a choking coil, and to thus lessen the chances of lightning damaging the latter; in other systems they are connected next to the ground in order to lessen the chances of trouble in themselves. If wired in this manner, when the motors are in parallel the maximum potential between the fields and ground is about 30 volts, when they are in series this is increased on No. 1 machine to 250 volts, No. 2 remaining as before.

The next point to be considered is the method of using the motors as an emegency brake. If the motors are driven by some outside force, such as momentum or gravity, they tend to generate current the same as any other dynamo, and if the connections of the field be reversed with respect to the armature, they will gradually produce more and more voltage, or build up, as it is termed. Further, if they now be connected in parallel, any slight difference in voltage between the two will start a current flowing which still further changes the field strengths and thus produces an increase in the current. This means that one machine becomes a generator with a heavy load, which tends to pull it up, this in turn through the gears tending to stop the car. The other machine becomes a motor with a heavy current forced through it and consequently a heavy torque, but being reversed instead of tending to drive the car forward, as does current from the trolley wire, this tends to drive the car backwards. It will thus be seen that the action of both machines is to stop the car, which will pull up quite sharply. Now, as soon as this has taken place the current ceases, and if the car be on a down grade it will immediately start again, and after it attains some slight speed the process will repeat itself; it is thus possible to take a car down hill without the aid of either brakes or current from the trolley wire. It should be noted that this method of stopping is quite distinct from that of using the main current with the machines reversed, further, that on a two motor controller the throwing of the reversing switch does not put the motors in parallel, they can only be connected in this way by means of the main cylinder which has to be turned to some one of the parallel positions, which is immaterial; with the current breaker open or the trolley off there is no closed circuit on any of the series steps. On the other hand, with a four motor controller, there being two pairs of machines permanently in parallel (except when equipped with a commutating switch set for series connection), all that is necessary to obtain the desired connection is to throw the reverse handle. Occasionally there are found two motors which are so nearly alike, or give results so closely allied that this action will not take place, though it is probable that 99 per cent. of the cars in service to-day will act as described above.

The foregoing covers, in outline only, the principal parts comprising the modern electric car equipment of medium capacity; it is obviously impossible, within the limits of this paper, to go to any extent into detail; there remains but to glance at its general properties compared with electrical apparatus designed for radically different service.

Compared with commercial stationary direct current machines having about the same armature speeds, we find that the street railway motor, horse power for horse power, weighs somewhat less than half as much as does the former, direct current machines of the lower speeds averaging 110 to 135 pounds per h.p.; the street railway motor somewhere about 65. You must further note that the latter machine has a momentary maximum output of two or three times its normal capacity, that is, a machine rated at 30 h.p., according to the methods adopted by standard practice to-day will for short periods give an output of 80 to 100 h.p., in fact there is to-day no other machine which, weighing but one ton and contained within the three dimensions of about 30 inches, will produce from 25 to 50 h.p. and this with a high degree of economy; obviously this result is obtained only by having a machine of the greatest simplicity composed of the very finest materials obtainable and built with the utmost attention to every detail.

Further, it is to be observed that some of the machines made for this purpose are by no means small. The first cars put into service were equipped with two motors of about 12 to 15 h.p., each weighing in the neighborhood of 2,300 pounds; to-day the ordinary car in city service has two 35 or 40 h.p. motors, weighing with the controlling mechanism about 3½ tons, the complete car averaging about 12 tons. The average car on interurban high speed service, equipped some with two motors and some with four, varying from 50 to 80 h.p. each, will weigh somewhere in the neighborhood of 25 tons, 8 to 12 tons of this being accounted for by the 200 to 300 h.p. of electrical equipment with which they are provided. Cars for elevated roads will average somewhere about 30 tons each, and as they are frequently run in trains of two and three, the complete outfit will weigh in the neighborhood of 100 tons. The Baltimore and Ohio Railway Company's locomotives are the largest electrical traction machines in use to-day; they weigh about 100 tons each, the motors, of which there are four, being rated at 325 h.p. each, the normal current input of the complete machine reaching the large total of 2,000 amperes.

It is obvious that, having such a fine equipment as the modern railway motor, we should make every effort to keep it in good shape, to get from it the maximum of service with the minimum of cost and to maintain a schedule free from the most annoying of troubles, road breakdowns, one of the most essential points to this end is a thorough system of inspection, without some such procedure it is hopeless to expect anything but that the repair accounts will be unduly large, and your customers far from satisfied with the service they receive. It is usual in modern railway practice to have two and sometimes three distinct times of inspection for each car, every road having a night man who makes a visual and more or less superficial examination each night, and a barn repair crew who dismantle and thoroughly overhaul every equipment at stated intervals of 6 to 12 or 14 weeks. To these some roads add the day inspector who visits each car when in service, examining the operation of the commutators and the controllers, and receiving reports from the crews as to any incipient defects which they know should receive attention.

The greatest aid to such a system of inspection, and in fact a prime necessity of its existence, is a set of books, as simple as possible, but nevertheless complete in that they show the date of every operation, both day and night, on each car, and the names of the men performing them, from records such as these you will be able to determine and accurately keep track of the date on which any car is due to come in for general overhauling. Having determined, from the class of equipment and the amount of work it has to do, the safe running limits of the machines, that is, the longest time which it is practicable to leave them on the road and still not run into danger of having breakdowns, it is highly desirable to keep the system in such shape that the cars come in very close to the periods set for them. Such a system as this, apart from lessening the cost of repairs and reducing the number of street breakdowns, has great value in another direction, namely, the question of damage suits. Accidents, as we have all been told so many times, will happen; happy is the man who, in the hour of trial, can produce complete records and show that the car equipment in question was inspected and overhauled on a certain specified date by men competent and familiar with this class of work, and pronounced by them to be in thorough workmanlike condition: he has gone far towards acquitting his company of that bugbear and foundation for so many claims, alleged negligence.

[Note.—The foregoing paper, presented at the last annual meeting of the Canadian Electrical Association in Quebec, was illustrated by a car equipment kindly furnished by the Quebec Railway, Light and Power Company, as was also the current to operate same.]

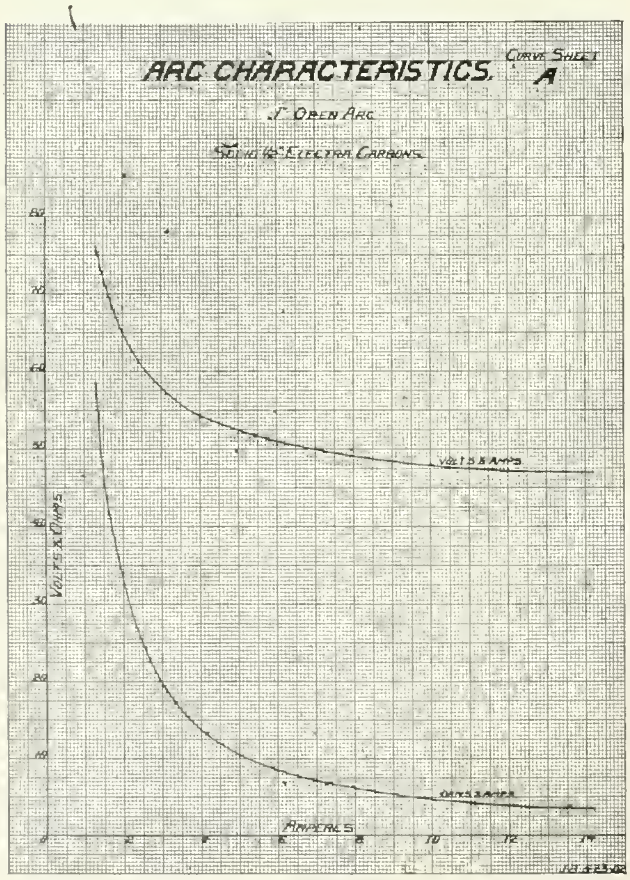
ARC LIGHTING.

By C. M. Green.

Arch light, now universally called "arc light," was discovered 100 years ago by Sir Humphrey Davey, 1802. It practically remained in the laboratory until 1877, when Charles F. Brush made its use possible to the commercial world by the following steps :

1st. The building of a dynamo suitable for operating a single arc lamp with a series magnet.

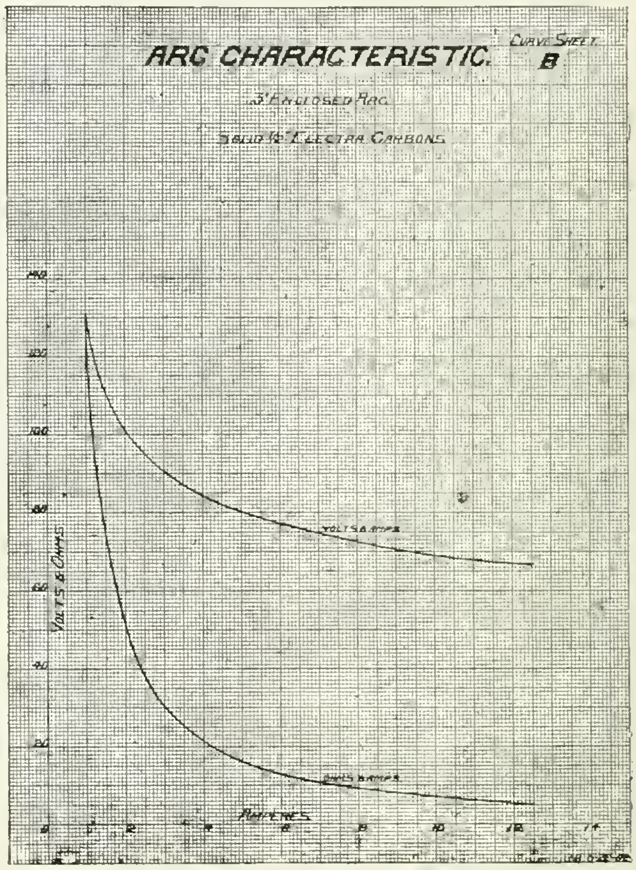
2nd. The multiple system of arc lighting, which consisted of a dynamo with two or more separate circuits, with a lamp connected in each one of the circuits. This system, however, could never be commercially successful on account of requiring a separate circuit between the dynamo and each individual lamp.



3rd. The series arc lighting system employing a new lamp with differential windings, thereby keeping the voltage across the arc constant as the carbon burned away while the current remained constant in the circuit. An automatic cutout in the lamp for maintaining the circuit closed after the carbon had been burned away. The different circuits in the dynamo were connected in series and a current governor or dial designed to maintain the current constant from the dynamo as the load changed by shunting more or less current from its series field.

4th. Copper plating and in other respects improving and cheapening the carbons, thereby reducing the price from 26c. to 1c. each, thus reducing the cost of maintenance and greatly extending the commercial field for arc lighting.

It remained for Elihu Thomson to do the great work of developing not only the series system but the alternating system of arc lighting.



The arc lamps for constant potential circuits were developed several years later than the series arc lamps.

CLASSIFICATION OF ARCS.

The direct current open arc lamp was first invented and commercially developed, meeting with a very extended use and giving univeral satisfaction; first on constant current series circuits and later on constant potential circuits.

The alternating current open arc lamp has never met with any extended use for the following reasons :

1st. The light is very inferior in comparison with that obtained from the direct current, unless expensive cored carbons are used, and even then it is not equal to the direct current.

2nd. The arc and lamp mechanism are extremely noisy, some of the series street lamps being easily heard at a distance of 200 or 300 feet on a quiet night.

The direct current enclosed arc was commercially developed in 1895-96, having the following points of superiority over the open arc :

1st. The life of the carbons was increased from ten to twenty times, greatly reducing the maintenance and attention required by the lamp.

2nd. The steadiness and distribution of the light is vastly superior.

3rd. The light giving body is very much larger; the enclosed globe also diffuses much of the light, the result of which is that the shadows have been eliminated, approaching diffused daylight.

ARC CHARACTERISTICS.

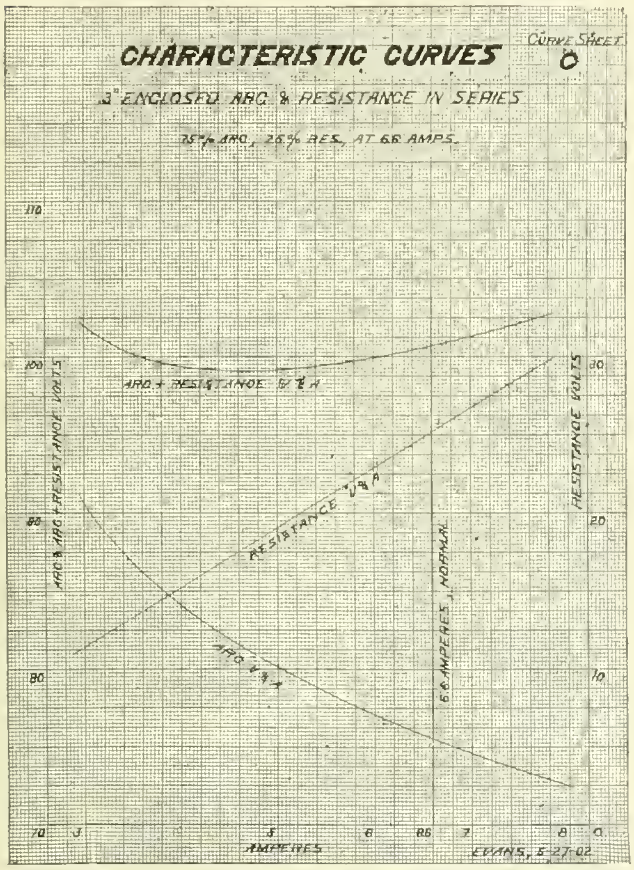
The arc characteristics or properties must be known in order to understand and handle the arc successfully.

The characteristic curves of the open and enclosed arc are shown respectively on curve sheets A and B. These are plotted in volt and amperes, and also in ohms and amperes. The data for the curves was obtained in the following manner :

A direct current constant potential was used to supply the energy. The current was varied by means of adjusting the resistance in series with the arc. The length of the arc was kept constant by hand adjustment, a magnified image being projected on a screen for obtaining accurate measurements of its length. Weston voltmeters and ammeters were used in making the observations; each point on the curve is the mean of several observations. The ohms resistance were calculated from the volts and amperes. Both arcs show the same general characteristics. The volts and more especially the ohms resistance decrease rapidly with the increase of current, which I attribute to the following cause.

It is well known that the resistance of a conductor varies directly as its length, inversely as its area and always varies with changes in temperature. The conductor in the arc is the vapor of carbon. In the experiments the length of the conductor or arc has been kept constant, the area of the conducting vapor varying with the current, the resistance also being reduced with increase of temperature due to larger area with proportionally less radiating surface. The temperature coefficient vapor of carbon is undoubtedly negative.

The weight of this conductor, the arc, is extremely small. The rate of production of energy in the conductor is extremely high and also the rate of dissipation is correspondingly high, and accordingly the resistance varies almost instantaneously with the current. The time spoken of here may be taken as a small part of a second.



The resistance of the 6.6 ampere 60 cycle alternating arc has been investigated and the following results have been observed. Instantaneous current value 8.6 amperes, arc resistance 7.5 ohms, likewise the instantaneous resistance value at one ampere was 80 ohms with a rising current, but only 60 ohms with a falling current. From theoretical consideration I should expect that if the rate of change in current was sufficiently slow that there would be found no difference in resistance for a given current whether the current was rising or falling, and likewise if the change was made sufficiently rapid, as for example running up into the thousandths of cycles per second, that the change would be much less due to the smaller time element and the relative larger capacity of the conductor for storing up heat.

From the above it is very readily seen that the arc is extremely sensitive to current changes.

It is easily seen upon investigation of the characteristic curves that an arc will burn steadily upon a constant current supply or circuit but not directly across any constant potential supply, and also two arcs, not lamps, cannot be run in multiple.

The characteristic curves, A and B, clearly show that if the arc is to be stable it must be supplied from a source of electricity in which, if the current rises, the voltage will decrease, or if the current decreases the voltage will rise at a higher rate than shown in the characteristic curve.

The constant current supply is the best, requiring a lamp designed to keep the voltage at the arc constant and to maintain the circuit closed when the carbons burn out.

The constant potential supply is the poorest, requiring a lamp designed for accomplishing the following things:

1st. To supply the arc so that the voltage at the arc will drop as the current increases and rise as the current decreases and at a higher rate than shown in the characteristic curves. This is obtained by wasteful resistance or reactance.

2nd. To maintain the voltage and current constant at the arc by feeding the carbons.

3rd. If two or more lamps are to be run in series there will be required in addition to the above for each arc a load or resistance to be automatically substituted for it when the carbons burn out or the lamp is shut off, in order to maintain the circuit closed and to prevent excessive or destructive current in the other lamps.

Arc lamps run upon constant potential circuits, with a steadying resistance in series with them, have been built for a number of years. For operating upon a 110 volt circuit the voltage at the arc normally, being about 80, it is found that if it is raised above this by cutting out some of the resistance the lamp does not operate satisfactorily, jumps badly in picking up, and also the arc is very liable to break. Theoretically, this is comparatively easily explained by reference to Curve Sheet C, characteristic curves of .3" enclosed arc and resistance in series, 75% arc, 25% resistance at 6.6 amperes.

The characteristic curve of the arc in volts and amperes is shown upon the curve on a magnified scale, showing the resistance of the arc somewhat each side of the point at which it is desired to operate it. The volts loss in resistance with varying amperes is also shown upon the curve. The curve, arc plus resistance volts and amperes is obtained by adding the volts arc to volts resistance for the different current values.

Examination of this curve shows that between 4.2 amperes and 5.2 amperes that the current may be changed between these limits with practically no change in the voltage whatsoever, showing that there is no stability between these points, i.e., the current may vary between these limits with no change in the voltage.

Examination of the curve between 6 and 7 amperes shows that a change in voltage from 100 to 101.25 volts, or 1¼% rise in voltage, will increase the current 16.7% or from 6 to 7 amperes. In other words, the arc even with 25% of the line voltage consumed in resistance in series with it, is not particularly stable, and the more resistance we put in series with the arc the greater stability we obtain, but in an extremely expensive manner, since we are continually lowering the efficiency of our lamp.

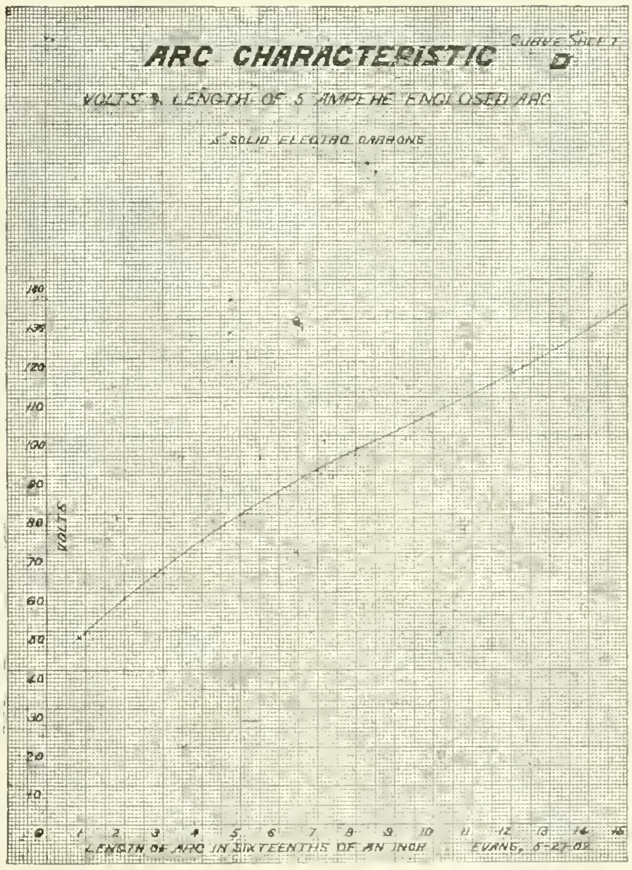
Curve Sheet D are characteristic volts and length of 5 ampere enclosed arc .5" solid electra carbons. A broad investigation of this curve shows that the volts at arc increase somewhat in proportion to its length plus about 40 volts. It apparently requires a certain number of volts to maintain an arc of extremely short length.

Investigation of this curve might lead to the opinion that the resistance of the arc might be kept constant by varying the length of the arc, but the arc is so extremely sensitive to variations in current that it is practically impossible to control the current in an arc lamp run across constant potential circuits in this manner.

The constant potential alternating arc lamps are invariably built with a reactance in series with the arc for steadying it, which has been found to be very much better than resistance for the following reasons:

1st. The lamp has a higher efficiency.

2nd. There is less distortion in the current wave supplied to a lamp with reactance in series with the arc than with resistance. In other words, the power factor of the arc is higher and there is comparatively little difference in the power factor of the lamp.



There are no arc lamps in commercial use operated in multiple on a series circuit. This method would seriously complicate the lamp and wiring and also greatly increase the losses. Sometimes a resistance has been put in multiple with a series lamp on a series circuit as a makeshift. For example, a series enclosed arc lamp, 6.6 amperes, run on a 9.6 ampere open arc circuit when it was desired to compare the two lamps without going to the expense of installing another dynamo and running on a separate circuit.

CANDLE POWER AND ARC EFFICIENCY.

Mr. W. D'A. Ryan, a great authority on the subject of Candle Power and Arc Efficiency, dealt with this subject very fully in the meeting of last evening. Accordingly, I shall simply mention briefly what appear to me five principal facts that he brought out.

1st. Of all the artificial lights the arc gives the one nearest approaching sunlight.

2nd. The great superiority of the enclosed arc in comparison with the open arc, better distribution of the light and also more light at a distance of 150 feet or more from the arc than that given by the open lamp, also the great absence of shadows. In other words it is the best artificial light which we have to-day.

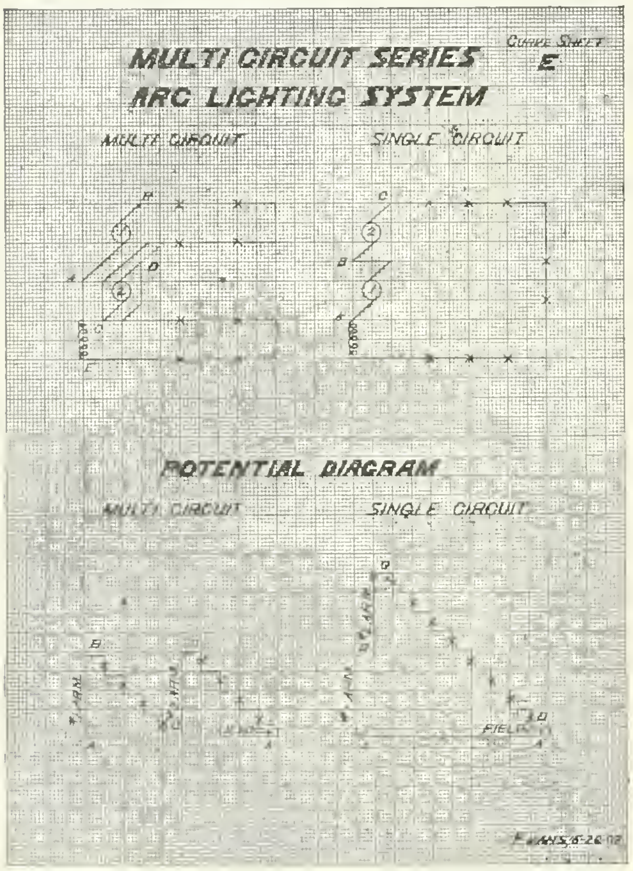
3rd. Great reduction in cost of maintenance of the enclosed over the open arc, the larger part of which is made up of carbons, followed by labor, with a few other smaller items.

4th. The enclosed lamp is more reliable, being entirely enclosed, and not affected by winds and snow.

5th. The design of lamps has been greatly simplified, the parts made interchangeable, the length and weight reduced—some of the greatest achievements of modern arc lamp engineering.

SUPPLY SYSTEMS AND TYPES OF LAMPS.

Generally speaking there are two systems of supply, the constant current series system and the constant potential or multiple system. The constant current or series system uses either direct or alternating current. Broadly speaking, there are only two types of lamps in commercial use to-day for the series system, namely, the differential and shunt lamps.



There have been many other kinds of lamps built embodying different methods of control, but none of them have the advantages of the differential lamp, the general details of which are well known to you all. The differential lamp I believe to be the best of the two for the following reasons:

1st. The lamp gives less trouble in operation. The characteristic curve of the lamp and that of the arc generators cross each other at full load, much nearer at right-angles than that of shunt lamp and generator, giving greater stability of operation.

2nd. The carbons are together and free when the current is turned on the lamp, whereas with the shunt lamp the carbons are separated and have to be brought together in order to establish the arc.

3rd. In case of an accident a generator may be largely overloaded with differential lamps by allowing the current to drop slightly, which will reduce the voltage on lamps, enabling a larger number to be run from the generator. Buffalo has run 100% overload in lamps in such cases, saving them large rebates to the city on account of keeping a large number of their lights in operation, which would have been impossible with shunt lamps.

It has been suggested that a shunt lamp possesses an advantage of operating at 6.6 amperes until midnight and at 5 amperes during the early morning hours. This is a fallacy. 95% of the central stations are committed by contract with the city or town to supply a specified current and wattage per lamp. The differential lamp is in harmony with this policy. Many central stations have an agreement with the city or town which has required them to equip their switchboards with recording ammeters which register the current at all hours.

The differential lamp is the most popular lamp to-day, and it is the general practice to build all series arc lamps with differential winding.

The constant potential or multiple system of distribution employing both direct and alternating currents, it is the universal practice of to-day to control all of these lamps by means of a series magnet, which makes the best and most economical lamp for this system. Lamps are built to run in series upon constant potential systems. For example, it is desired to operate arc lamps, a few of them only, on railway or 500 volt power circuit. In this case four or five enclosed lamps are run in series, but controlling mechanism is of the differential type, the current in the series magnet tending to separate the carbons, and the current in the shunt magnets controlled by the voltage across the arc operates in opposition to the series magnet, tending to pull the carbons together, or, in other words, it is a lamp built somewhat upon the plan of the best lamps to-day for series circuit with slight modifications as follows:

There is a steadying resistance always in series with the arc and also another resistance equivalent to the resistance of the arc which is automatically substituted therefor when the carbons burn out or it is desired to shut off the lamp.

GENERATING APPARATUS.

The generating apparatus is divided into two broad classes:

1st. Constant Current.
2nd. Constant Potential.

The constant current generators manufactured to-day are all direct current series wound machines with armatures either of the open or closed coil type. The Thomson-Houston and Brush arc generators are of the open coil type, and Fort Wayne and Western Electric of the closed coil type.

The regulation in these generators is always obtained primarily by armature reaction with the shifting of the point of commutation and brushes, with the following secondary refinements for keeping the current constant as the load changes:

(A) Varying the field excitation. Example, shunting more or less current from the series field and shifting of the brushes by an automatic regulator as found in the Brush arc generator, or varying the turns in the series field and shifting of the brushes by an automatic regulator as found in the old Excelsior or Hockhousen arc dynamo.

(B) Varying the armature reactions; using double sets of brushes on the commutator so that more or less turns in the armature can be cut out or run for a longer time in parallel, thereby changing the armature reactions. The Fort Wayne or Wood arc dynamo is an example of the first case, the T. H. arc dynamo of the second, the brushes being controlled in each case by an automatic regulator.

Generators in which the secondary regulation is secured by varying the field excitation are theoretically of higher efficiency than those in which the regulation is secured by varying the armature reactances.

There is comparatively little difference in the two methods as far as losses go whether the field excitation is changed by means of shunting more or less current or commutating the field.

Generators with open coil armatures are in my opinion superior to those with closed coil armatures in the following respects:

1st. The voltage at the terminals of the generators on breaking of the circuit will not rise over 20% above the maximum voltage which the machine will supply at normal current, whereas with machines of the closed coil type, the voltage rise is very much greater, in fact, so much so that certain machines of the closed coil type have been provided with spark gaps in order to prevent the voltage from rising excessively high when the circuit is opened.

The low voltage rise on the open coil generator is due to the fact that when a slightly greater load is thrown on the machine the point of commutation is drawn back under the brush and the generator then flashes over, short circuiting the armature, but doing no damage; while the generator with the closed coil armature flashes over at a very much higher voltage with the liability of breaking down the insulation, short circuiting some of the armature coils or commutator segments, to be followed by burnouts.

2nd. The great reduction in the number of commutator segments in comparison with generators of the closed coil type. For example, the Brush arc generator has only 32 segments as compared with five times as many on generators of some other types.

THE CONSTANT CURRENT SERIES ALTERNATING SYSTEM OF ARC LIGHTING.

Alternating constant current generators are not built to-day, but constant current transformers are run on constant potential alternating current generators, for obtaining constant current from constant potential generators and always in connection with some other service on the generators.

These generators are too well-known to be taken up here.

The constant current transformer is designed with movable secondary or primary coils for varying the voltage from secondary with constant current in it as the load changes. This is accomplished by varying the impedence and secondary voltage in the transformer by changing the relative position of the coils.

Mr. Greene is the inventor of the British Multi-Circuit Machine.

The current in primary and secondary coils being in the opposite direction, they repel each other. The repulsion varies with changes in current and is balanced by weights attached to the movable coil. When the load is increased the current drops, the repulsion is reduced, and weights bring the two coils closer to each other, thereby bringing the current back to normal value. If the load is reduced the operation is reversed.

The constant current transformer requires the same amperes supply, irrespective of its load. The power factor, however, changes with the load.

Constant current transformers are built for single or multicircuits. The arc circuits are always insulated from the supply circuits and never more than two multi-circuits run in series, thereby greatly reducing the liability of interruption in the service by grounds, one ground on every circuit not interfering with the service except on the multi-circuit, and one ground on the two circuits here does not affect the service.

Series arc lamps are run with a variable reactance in series with them, for maintaining the current constant across constant potential alternating mains, but the trouble due to grounds upon a large system of this nature makes the service very unreliable, so much so that this system has never come into extensive use.

When it is desired to operate arc lamps from large polyphase systems of distribution, employing 25 cycles, a motor generator set is usually installed, since the light from a 25 cycle arc is very unsatisfactory, fluctuating unless a polyphase arc is used; also the lamp is complicated and must be designed for low voltage on account of danger and expense involved if high voltages were introduced into lamps between phases, which means an expensive and complicated system of wiring and transformers, which has not been developed. A lamp could be built with comparative ease for 110 volt circuits, but the field is small.

THE MULTI-CIRCUIT SERIES ARC LIGHTING SYSTEM.

The multi-circuit series arc lighting system was invented in February, 1896, and was exhibited at the Electrical Exposition in New York in May, 1896.

This invention has been widely used on arc generators and its use on constant current transformers is increasing rapidly.

Curve sheet E shows the connections of the multi-circuit and single circuit systems. It consists in dividing up the generator and load into two or more parts, interposing the parts in a series combination, readily understood by examination of the curve sheet.

The single circuit arrangement is shown in the diagram to the right, from which it will be noted that the two armature circuits are directly connected in series with the field between D and C. The lamp load is connected between C and D.

The object of the multi-circuit system is to reduce the voltage or increase the capacity of the generator without increasing the voltage, and this is accomplished as shown on the potential diagram on Curve Sheet E.

It is a well known fact that the algebraic sum of all the electro motive forces in any circuit is equal to zero. We have plotted on the curve sheet the potential diagram for the multi-circuit and single circuit connections, wh'ch shows that the two circuit multi-circuit machine carrying the same load as a single circuit machine reduces the voltage practically 50 per cent.

The writer has also run other arc dynamos connected multi-circuit.

Constant potential generators are too well known to be discussed in this paper. They were developed tor an entirely different service; but it is frequently desirable to operate arc lamps from them, but always in connection with some other service, and forming but a small part of their load.

PLANT EFFICIENCIES AND LOSSES.

ENCLOSED ARC LAMPS CONSUMING ABOUT 480 WATTS.

System	Series		Multiple	
Current	Dir.	Alt.	Dir.	Alt.
Light................	1.00	.98	1.00	.98
Lamp................	.95	.94	.727	.89
Line................	.95	.935	.90	.90
Generator............	.88	.93	.94	.93
C. C. Transformer....	...	.96	...	...
Power Factor	...	.78	...	.71
Cycles...............	...	60	...	125
Plant Efficiency......	.794	.768	.615	.73

CONCLUSIONS.

1st. The enclosed arc is better and cheaper to operate than the open arc.

2nd. The direct constant current enclosed arc system is best and most economical for plants devoted exclusively to arc lighting.

3rd. The alternating constant current enclosed arc system is best and most economical for plants which use large 40 to 125 cycle alternating current generators, the arc lamp load being a small part of the total output of the station.

4th. Constant potential direct and alternating current arc lamps are very extensively used on constant potential systems of distribution for inside lighting, and somewhat tor street lighting, but only when there are special reasons for so doing.

FUTURE DEVELOPMENTS.

There is great need of a rectifier apparatus for transforming three-phase 25-cycles constant potential into direct constant current for series arc lighting, which shall cost less and have a higher efficiency than the motor-generator sets of to-day. I believe it is only a question of time when we shall have a commercial rectifier.

Single phase rectifiers have been in use for some years in Europe, but with enclosed lamps there is little advantage in rectifying the current, and the apparatus is much more complicated.

We are living in an age of inventions or discoveries. Some one may invent or discover a new lamp which will greatly increase the light obtained per watt.

As a matter of interest, I desire particularly to call your attention to the present arc lighting situation at Buffalo, N. Y., and other places.

The Buffalo General Electric Company were among the very early users of arc apparatus and have been operating it for upwards of twenty years, during which time very radical changes and great improvements have been made in arc apparatus. They are at present using upwards of 3500 open arc lamps, the current for which is supplied by 26 arc dynamos, each rated at 6250 volts, 9.6 amperes, 500 revolutions per minute. These generators are driven by three-phase synchronous motors, the current for which is supplied from Niagara Falls.

The managers of the Buffalo Company have decided to change their system of arc lamps, and the subject, both financially and otherwise, being a very important one, they have made a very careful examination of the present arc lamp situation and have decided to rewind their 26 arc generators for 8500 volts, 6.6 amperes, and to adopt the enclosed direct constant current series arc lamp.

The direct and alternating current systems of series enclosed arc lighting were very carefully investigated and it was found that the cost of changing over the present arc generators from 9.6 amperes to 6.6 amperes would amount to about half as much as to purchase alternating current generators and constant current transformers.

I might call attention to the fact that the supply from Niagara Falls is 25 cycles, which is entirely unsatisfactory for operating arc lamps, the frequency being too low, which necessitates either a frequency changer or a motor generator set in order to get satisfactory current for operating arc lamps. Furthermore, the efficiency of the arc generator, equipped with laminated pole shoes and armature shield, will be practically the same as the alternator and constant current transformer. The direct current line losses will be much less, since they would require 7.5 amperes in place of 6.6 amperes for their arc lighting circuits, in order to give the same number of watts in the lamp or arc.

Boston has been operating the series direct current enclosed arc system since 1898. They have in use 50 arc generators, 8500 volts, 6.6 ampere, 500 R. P. M., direct connected to synchronous motors. Capacity, 6000 enclosed arc lamps.

Toronto has been operating for a number of years arc lamps, the current for which has been supplied by arc generators. I should not be at all surprised to see these generators rewound for 6.6 amperes for lighting the streets of Toronto with enclosed lamps, the generators to be driven in the near future by synchronous motors supplied with power from Niagara.

Parties who are interested in changing over their open to enclosed arc lamps should give due consideration to the direct constant current enclosed series arc lighting system. While they are operating at present a number of small arc machines they could make a large saving by the introduction of large size units.

Where their present system already consists of large units wound for 9.6 amperes the machines can be rewound for operating enclosed arc lamps, affording a great opportunity for effecting economies and improvements.

CONVENTION NOTES.

The Ladies' Committee were indefatigable in their efforts to give the lady visitors a good time, and they succeeded admirably.

The town of Levis erected on the bank of the St. Lawrence in honor of the visitors a mammoth electrical sign bearing the word "Welcome."

It was a matter of general regret that on account of illness in his family Mr. Frederic Nicholls was prevented from being present at the meeting,

The supply firms were well represented both in numbers and in ability and good fellowship. The United States contingent was quite as large as the Canadian.

Mr. Marconi was unfortunately not able to attend and present a paper at the Convention as he had expressed a wish to do. It is to be hoped that he may be able to take part in next year's Convention at Toronto. The coming year should witness further interesting developments in the field of wireless telegraphy.

The Quebec Railway Light and Power Company has in Mr. Evans a very able and wide awake manager. In consequence the service is thoroughly up-to-date and grows increasingly profitable.

As a very suitable memento of the Convention the Mechanics' Supply Company distributed a set of very handsome souvenir or private post cards illustrative (in color) of prominent Quebec views. They were very much admired.

The unavoidable absence of Mr. A. B. Smith, of the G.N.W. Telegraph Co. was a matter of regret to his many friends in the Association, who showed their appreciation of his past faithfulness and efficiency by re-electing him to the Executive Committee. This was the first Convention of the Association at which Mr. Smith was not present.

The menu card for the Association banquet was a unique production, and was among the most highly prized souvenirs of the convention. It showed the Citadel, the Chateau Frontenac, the Dufferin Terrace, the Embankment, the St. Lawrence and the steamer Quebec in their natural position in relation to one another. The steamer and Chateau were cut out in cardboard. On the reverse side of the card. which was arranged to fold up, was printed the menu and toast list.

Among the attractive and useful souvenirs of the Convention distributed by the manufacturing companies was a match holder in the form of a transformer, by the Canadian General Electric Company; a pocket memorandum book with celluloid covers, bearing on the front figures representing Industry, Art and Commerce and the compliments of Mr. John Forman, and on the back an illustration of the Gutman Standard Wattmeter; a daily directory by the Bullock Electric Mfg. Co. of all persons in attendance with a number opposite each name corresponding to the number on a button supplied to and worn by each member and visitor. By reference to this unique directory and the numbered buttons, the identity of persons in attendance could be readily ascertained.

The decorations both in the rotunda of the Frontenac hotel and on Dufferin Terrace, put up by the National Electrical Improvement Company, of New York, under the direction of Mr. Russell Spaulding, General Manager, were of a very attractive character and were greatly admired. The "Elblight" system of which this company are the owners, is especially adapted for work of this description, and permits of an attractive display at small cost. The lamps are fitted with sharp pin terminals which pierce the insulating material and make contact with the cables, which are made up of strands of wire put together in such a way as to make contact certain wherever the lamp may be placed. The ingenuity and usefulness of the system attracted much attention. It is understood that the National Electric Improvement Company are seeking to establish a Canadian company to manufacture in this country.

AN IMPORTANT CONSOLIDATION.

After protracted negotiations the Lachine Rapids Hydraulic & Land Company, of Montreal, and the Shawinigan Water & Power Company, of Shawinigan Falls, Que., have come to an agreement by which the latter corporation will deliver power to the city of Montreal and surrounding municipalities to the Lachine Company for distribution. The deal is of great importance, as it places the Lachine Company in an excellent position to supply almost any demand for power which may be made upon it. The contract is for twenty-five years, with privilege of renewal for twenty-five more.

According to the contract the Shawinigan Company agrees to deliver all the electrical energy demanded by the Lachine Company, and it is further understood that the two companies shall retain their present identity and that there shall be no intermingling of management. The present development at Shawinigan Falls is about 35,000 horse power, but conservative estimates place the maximum at 100,000 horse power. The Shawinigan Company is now engaged in constructing a transmission line along the Great Northern Railway Company's right of way between Shawinigan Falls to Joliette, and from thence over the Chateauguay and Northern Railroad and the Montreal Terminal Railway Company's right of way into the city of Montreal. Immediately at the outskirts of the city a sub-station will be built, into which the current will be carried from the transmission line and transformed to suit the requirements of distribution.

QUEBEC PROVINCIAL ASSOCIATION OF STATIONARY ENGINEERS.

At the annual meeting of Montreal Association No. 1 the following officers were elected: President, J. T. Murphy; 1st Vice-President, J. E. Jones: 2nd Vice-President, J. O. Rourke; Treasurer, T. Ryan; Recording Secretary, Wm. Smyth; Financial Secretary, H. Nuttall; Corresponding Secretary, R. Marchand; Conductor, A. Adams; Door Keeper, G. A. Adams; Librarian, Wm. Ware; Educational Instructor, E. Valiquette; Trustees, Wm. Ware, J. J. York, F. D. Jones.

There was a good attendance of the members. All the offices were closely contested, which speaks well for the interest taken by the members in the meetings. A new era of prosperity seems to have dawned upon the Engineers of Montreal since the amalgamation of all the societies and the forming of an Executive Board. The educational feature promises to be an interesting one in future under the able leadership of Bro. Valiquette. A paper is read each night by some brother and discussed on the black board, when a wide range of ideas and opinions are brought out. The executive also offer prizes for the best papers on certain subjects. The present one is, "What are the duties of an Engineer!"

ONTARIO ASSOCIATION STATIONARY ENGINEERS.

The annual meeting of the Ontario Association of Stationary Engineers was held in the Engineer's Hall, Toronto, on May 26th, at which the reports of the Registrar and Treasurer were received. The Registrar reported the total number of certificates issued as 1,075, of which 100 will cover lapsed certificates and deaths. The Treasurer reported funds to the amount of $229.00 on hand.

A report was submitted from the Legislation Committee setting forth the action of the Governments' amendments to the Factories Act and showing that the amendments in their present form are not much use to either the steam user or the engineer. A strong committee was appointed to take the matter up at the next session of the Ontario Legislature. It was also ordered that the Union label be placed upon all printed matter done for the Association. The Board Members elected were Messrs. F. W. Donaldson, Toronto; F. G. Mitchell, London; W. F. Chapman, Brockville; J. G. Bain, Toronto.

The officers elected by the Board were, President, F. W. Donaldson; Vice-President, Chas. Mosley; Registrar, J. G. Bain, 113 Yorkville ave., Toronto; Treasurer, A. M. Wickens, Toronto. The business of the day was concluded in time for the members to take the evening train for their homes.

The annual meeting of the Montreal Light, Heat & Power Company was held in Montreal last week. The chairman stated that the present year had every promise of being even more profitable than the one just closed. There had been some delay in completing their new transformer plant on Queen street owing to inability to secure machinery. The development of the water power of the St. Therese Rapids, three miles above the Chambly power house, would materially increase the company's capacity and would do away with the interference of frazil ice. The old board of directors was elected.

A QUEBEC ELECTRIC SUPPLY HOUSE.

The largest electrical supply house in Quebec is that of the Mechanics' Supply Co., of which Mr. W. H. Wiggs is the sole owner and manager. He is ably assisted by his head clerk and buyer, Mr. Guy Simpson.

Owing to the introduction of several new electric companies into Quebec within the last few years the demand for electrical material has been considerable and early recognizing this demand the Mechanics' Supply Company added a very extensive electrical stock in charge of competent and trained clerks.

In addition to electric lighting supplies they also carry a full line of telephone and telegraph material and are now making arrangements for the introduction of wireless telegraph and telephone material as soon as these systems are on the market.

THE MECHANICS' SUPPLY COMPANY'S SHOW ROOM, QUEBEC.

One of the reasons of Mr. Wiggs' success is his firm belief in the use of judicious advertising and printers' ink, and some of his samples of printed matter which we have seen are second to none in Canada or the United States.

The Company are extensive importers of electroliers, shades and glassware of all kinds from England, Germany, Austria and the United States.

It is a great advantage to any community to have such an establishment as this at their disposal.

PERSONAL.

Mr. Arthur Cox, for many years treasurer and superintendent of supplies for the Great Northwestern Telegraph Company, has decided to resign his position this fall, and will spend the winter pursuing his art studies in England and France. His long connection with the above company brought him in contact with the business men of Toronto and the country at large, who will regret to learn of his contemplated removal from Canada.

Mr. R. C. C. Tremaine, manager and part proprietor of the electric plant at Exeter, Ont., died at his home in that town a fortnight ago, of peritonitis. Mr. Tremaine was but 27 years of age. He was a graduate of the School of Practical Science, Toronto. After graduating he spent a short time in the Maritime Provinces, removing to Exeter about five years ago and becoming joint proprietor with Mr. Charles Shell in the Exeter Electric Light Company. He had become most popular in the town and will be greatly missed in social and business circles.

The Toronto branch of the Canadian Stationary Engineers have elected the following officers for the ensuing year: President, R. H. Johnston; Vice-President, James Bannon; Recording Secretary, W. H. Johnston; Financial Secretary, N. V. Kulham; Treasurer, S. Thompson; Conductor, R. T. Liddell; Door-keeper, W. G. MacLean. Trustees—James Bannon, Wm. Outhwaite, T. B. Bly. Representatives to convention—N. V. Kulhman, A. Storer, W. J. Webb, and R. H. Johnston. The annual convention of the Association will be held in Toronto next month.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,

Montreal, July 5th, 1902.

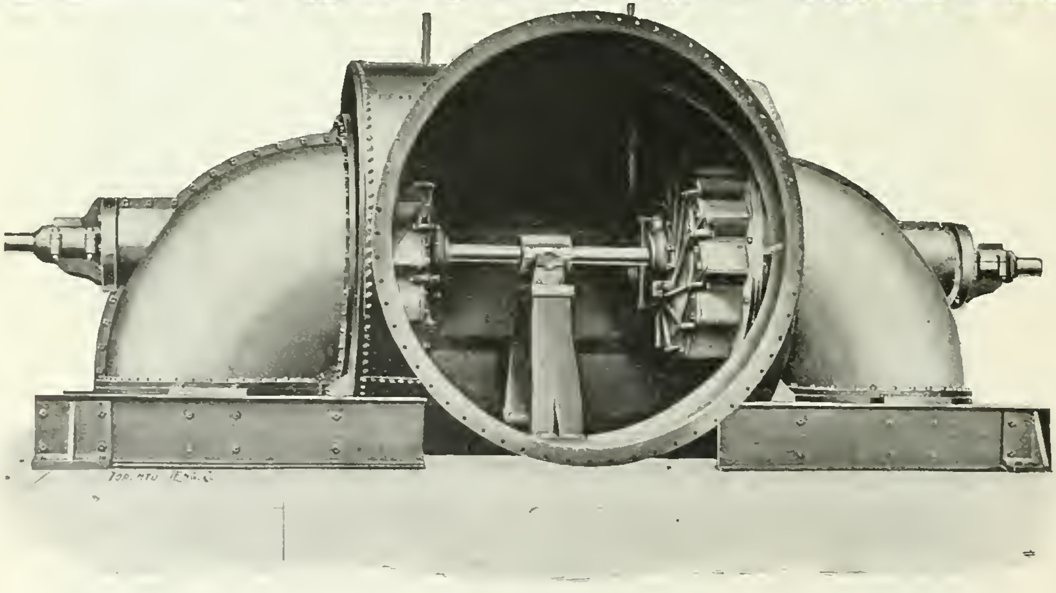
An understanding as to prices has been arranged by the various Montreal supply houses on "staple goods" such as wire, rosettes, sockets, cord and the like. The prices are based on a sliding scale as regards quantity purchased. The legitimate contracting firms are not at all satisfied, claiming that on our hand there is nothing to justify the enormous advance even on maximum quantity list from prices they heretofore sold at. The minimum quantity list is again not scaled high enough to give the contractor who does not carry much stock, adequate protection from the public at large. The question of "who is a contractor" has not been looked into sufficiently as the "tramp" in many instances has been receiving most favored nation treatment.

By a strange irony of fate the employee of an electrical concern in Toronto who as "walking delegate" to the Electrical Workers' Union, came down here some months ago to (unsuccessfully) engineer the strike will be having his hands full right at home if what the newspapers tell us about the strike in Toronto be true. How would the Toronto fraternity like a Montrealer sent up there now to stir up strife ?

The practice of several large companies of filling vacancies when such occur by Americans is strongly to be condemned. We have just as good in Canada, not to speak of the fact that the "assistant" to such "head of a department" is somewhat familiar with the work (to say the least) and should be given a "show." Nothing takes the heart out of a man quicker than to see Americans dropped in over his head without rhyme or reason and his chances of advancement (no matter how hard he works or attentive he may be to his duties,) made practically nil.

Here is a sample of contract wiring as it is done in Montreal : A contracting wireman installs 15 outlets, "skeleton concealed" work, at the rate of 75 cents per outlet. This comes to $11.25 ; out of this he pays $7 for inspection and certificate leaving him net $4.25. Query—Where does he buy his material and what wages does he pay ?

The Electrical Contractors' Association for the Province of Quebec has just lately organized, the first regular meeting having been held on 23rd June. The object of the Association is to get proper recognition for the legitimate contractors, and interchange of views, etc., among its members. As considerable jealousy has heretofore existed, it is our hope that the boys by the formation of this Association will get together, know one another better, and furnish mutual aid. The step is a good one and may lead to greater things in the future than at present imagined. The following officers have been elected for the ensuing year:—President, Wm. B. Shaw, of Montreal Electric Co.; Sec'y-Treas., Geo. S. Hill; Executive Committee, W. H. Scott, of J.E. Scott & Co.; G. N. Brock of Collyer & Brock; Jas. Bennett, of Bennett & Moncel; among other firms not already mentioned above, the following are interested in the success of the Association:—Sayer Electric Company; Telfer, Telfer & Company; Edwin C. Lewis Company. The intention later is to show its workings and by-laws to those interested in Toronto, have them do likewise and affiliate.



The above plate shows a pair of 35 inch Crocker Turbines, in horizontal setting, outward discharge type. This arrangement can be placed in any part of the line of shafting, when circumstances permit of direct connection, power being taken off on both sides of the case if desired. We have designs for many other styles of setting. Estimates and catalogue promptly forwarded to those applying and stating conditions under which power is to be developed.

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Toronto, Montreal,
Halifax, N. S.
Rossland and
Greenwood, B. C.

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CANADA.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

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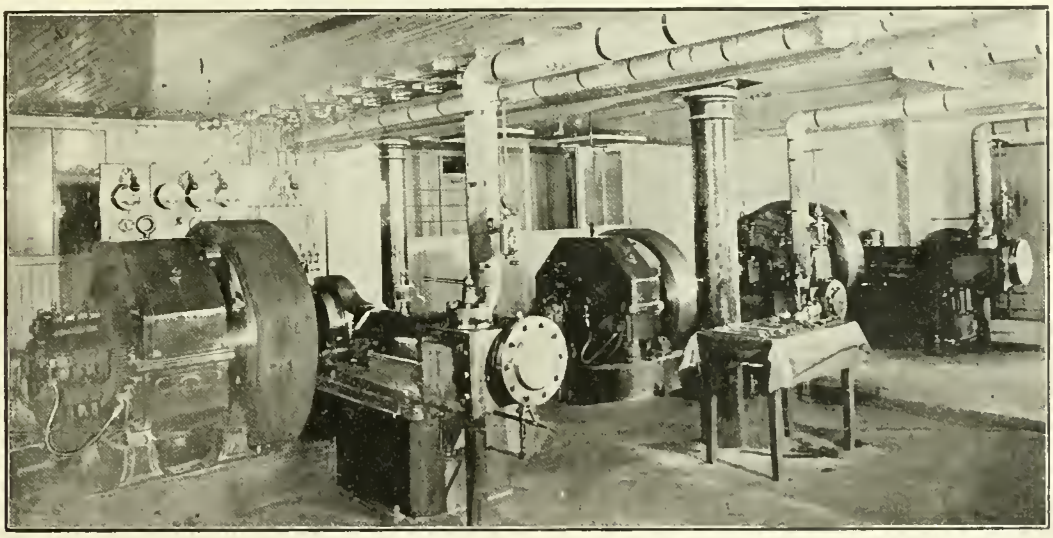
ELECTRIC PLANT FOR THE HUDSON'S BAY STORES.

Prior to 1899 the Hudson's Bay Stores in Winnipeg were lighted exclusively by gas, but in that year a large addition was made to the building and an isolated electric plant was installed. This was put into use first in May, 1900, and at that time there were in operation two high speed engines direct connected to the dynamos. The former are of the Robb-Armstrong side-crank type and are of 60 and 30 h.p. respectively. The dynamos were furnished by the Western Electric Company, of Chicago, and are 40 and 20 k.w. capacity respectively. With the extension of the business it was found that these engines and generators were not sufficient to supply all the current required, and another 60 h.p. engine and 45 k.w. dynamo of the same makes as the others were added in 1901.



Electric Plant in the Hudson's Bay Stores, Winnipeg, Man.

All the main departments of the stores are lighted by incandescent arc lamps, there being sixty of these in use, besides many hundreds of the ordinary 16 c.p. incandescent lights. The sewing machines and pressing irons in the tailoring and dress-making departments are operated by electricity generated by this plant, as are also the motors for driving the cash system throughout the stores.

There are one Robb 100 h.p. boiler and two Leonard 75 h.p. boilers, which, in addition to heating the building and driving the engines and generators, furnish the power for the pumps used in connection with the several elevators in the building.

SUCCESSFUL STUDENTS.

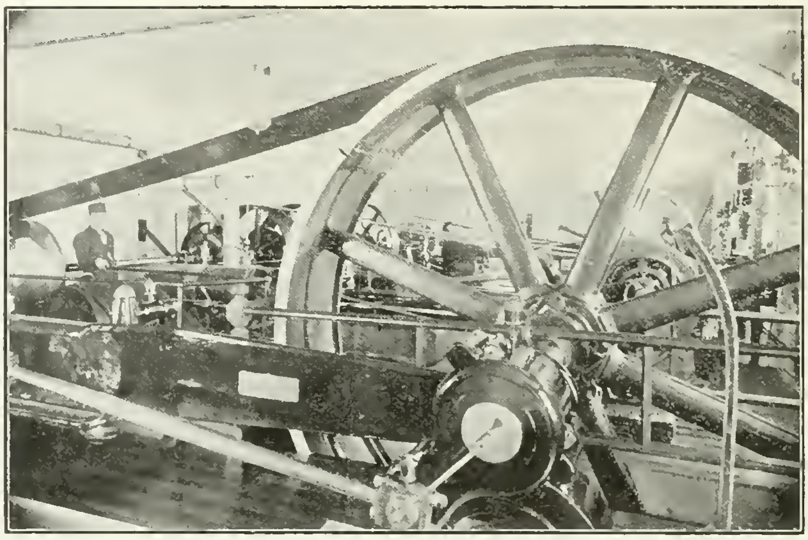
The following students were successful in the mechanical and electrical course at the spring examinations of the School of Practical Science, Toronto :

Honors—First Year—J. H. Barrett, S. E. Craig, W. S. Gibson, C. P. McGibbon, A. E. Pickering, M. R. Riddell, R. S. Smart, S. E. Thomson. Second Year—J. H. Alexander, H. H. Angus, F. A. Gaby, C. A. Maus, M. L. Miller, D. K. Pinkney, H. M. Shipe, H. G. Smith, S. B. Wass. Third Year—H. G. Barber, R. J. Dunlop, C. H. Marrs, D. Sinclair, T. Taylor.

Pass—First Year—H. E. Beatty, J. C. Boeckh, R. J. Burley, F. W. Burnham, J. W. Calder, A. M. Campbell, W. M. Currie, W. K. Greenwood, C. J. Harris, T. D. Henderson, P. V. Jermyn, J. W. Johnston, W. S. H. Keefe, A. H. Legge, O. B. McCuaig, C. D. McKay, C. J. Manson, E. E. Moore, W. H. Munro, J. J. O'Sullivan, C. Pace, W. S. Pardoe, W. J. Peaker, G. S. Roxburgh, F. N. Rutherford, P. M. Sauder, F. W. Slater, W. J. Smither, C. J. Townsend, B. B. Tucker, J.B. Watson, W. F. Wright, P. M. Yeates. Second Year—H. G. Acres, J. A. Beatty, A. E. Davison, C. J. Fenson, J. G. Jackson, C. K. Johnston, A. G. Lang, W. J. Larkworthy, J. A. McFarlane, P. H. Mitchell, E. E. Mullins, J. P. Oliver, J. D. Pace, B. B. Patten, R. B. Ross, H. S. Small, S. L. Trees, J. A. Whelihan, H. F. White. Third Year—J. M. Brown, W. Elwell, A. C. Godwin, C. Henwood, D. M. Johnston, A. H. McBride, J. T. Mackay, J. F. S. Madden, P. Mathison, R. S. Mennie, H. D. Robertson, W. H. Sutherland, A. A. Wanless, H. Zahn.

THE CENTRAL ELECTRIC COMPANY.

One of the first electric companies to be established in Manitoba was the Central Electric Company, Limited, of Portage la Prairie. This company was formed in 1890, since which time its business has gradually increased. The power house is a frame structure 67 x 68 feet, on a stone foundation. The engine room is 33x67 feet and the boiler room 35 x 67 feet. The first boiler installed was one of Goldie & McCulloch's make, 54 inches diameter by 14 feet. This boiler was reset two years ago, at which time the boiler capacity was increased by two Leonard boilers, single sheet, 72 inches diameter and 16 feet long, of 150 h.p. each, tested to 200 pounds cold water pressure. The boilers are bricked in with outer wall of three bricks thick, then a three-inch air space and then an inner wall of two bricks thick, lined with fire-brick up to the lugs. This method of construction has been found very satisfactory and to well repay the cost. The smoke-stack is 75 feet high and 42 inches in diameter, 60 feet of which is of heavy iron on a 15-foot brick base, the smoke-box connecting same with the boiler. The boilers are fed by column pumps and there is also a duplex steam pump as an auxiliary which can be used either for feed or for fire protection. Usually about 125 pounds of steam are carried.



Central Electric Company, Portage La Prairie, Man.—Engine Room.

A Wheelock cross compound, condensing engine, furnished by the Goldie & McCulloch Company, of Galt, was at first installed. The pressure cylinder is 13x34, low pressure cylinder 24x34, and fly wheel 12 feet diameter and operating at 92 revolutions. This engine has been in contniuous use since installed. Two years ago, on account of increased load, it was decided to put in a Brown engine, single cylinder 13x34, with fly wheel 11.6 feet, operating at 92 revolutions. This engine is only used for a few hours daily during the heavy load in winter time.

The dynamo plant consists of one 75 k.w. and one 40 k.w. National machine put in at the original installation, and one 150 k.w. S.K.C. machine, with marble switch-board and instruments complete. The latter machine was installed two years ago and has given perfect satisfaction.

The officers of the Central Electric Company are: President, Robert Watson; vice-president, Jos. Martin; secretary-treasurer, D. B. Hanna. The management of the plant is in the hands of Mr. J. W. Clayton.

The town of Campbellton, N. B., have purchased one 175 h. p. Robb-Armstrong automatic engine and one 175 h.p. Mumford standard boiler from the Robb Engineering Company, Amherst, N.S.

LEVIS COUNTY RAILWAY COMPANY.

Progress on the new electric railway in Levis, St. Joseph, Bienville and St. Romuald, the town across the St. Lawrence River from Quebec, goes steadily forward. The mortgage, or deed of trust, to the New York Security and Trust Company was recently recorded at the Levis Registry office.

The car barn of the company is situated on Fraser Street, and is in full view of the Terrace in Quebec. It is a very pretty and substantial structure, with brick walls and wooden roof. The two pointed towers on the front face the river and are each to be surmounted by a flag-staff. This building at present is receiving its roof.

The brick sub-station building was completed several weeks ago, and on July 17th the machinery foundations and the cement floor were finished. The switchboard was shipped by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, and was received about the twenty-fifth of July. The motor-generators are to follow in two weeks. Power at 10,000 volts has been contracted for with the Canadian Electric Light Company. There is a mile and a half of street trenched, and with the ties laid, stands ready to receive the steel rails which are being shipped from Sault Ste. Marie. The ties are distributed along the greater part of the streets. There are five miles of poles erected. All the overhead material has arrived and will be put in place as soon as the rails are laid. The private telephone system is completed and in operation.

The cars and equipment will be ready about the time the rest of the construction is finished, which will be about the end of August. A 350 feet trestle is being built at one part of the line and the piers for reception of a sixty-five foot steel bridge across the river will be ready early in August.

The electric elevator up the side of the cliff, opposite the Intercolonial Railway Station, is in the hands of the Fensom Elevator Works, of Toronto. The face of the cliff where it is to be located has been grubbed and cleared for reception of the steel work. Altogether, the outlook is most promising that the Levis County Railway will be running before Fall.

The Weston Electric Company, Chicago, through their Canadian agent, E. Irving, Toronto, have secured the contract for the installation of a new series alternating arc light system for the city of Brockville. The installation consists of one 50-light equipment and one 25 light equipment, including lamps, automatic regulators, air cooled transformers and marble switchboards.

QUESTIONS AND ANSWERS

"R. L.," London: We are running a Wheelock engine which is sometimes overloaded so that the governor does not trip the steam valve; will this hurt it? What shall we do to overcome it?

Ans.: The fact that your engine takes steam all through the stroke, which is the case when the governor does not trip the valve, will not of necessity hurt the engine, though it is an indication of a severe overload which is going to give trouble from straining the various parts, such as main bearing, crank pin, etc., which as a rule are not designed to stand such heavy duty for any extended period. The proper remedy is to put in a larger engine; if you cannot reduce the load, perhaps it might be possible to change some of your pulleys, which, while keeping the shafting speed the same, would allow you to speed up the engine. This, with the increased steam pressure, might help matters somewhat.

"Electrician": Would you please advise me what is the best way to arrange my switches when connecting together two compound wound dynamos, first, to run a three wire service, and second, in parallel.

Ans.: For a three wire plant you will need two double pole switches, one for each machine, and what is called a break-down switch, which is triple pole triple throw, wired to the lines so as to connect them three wire onto both machines when thrown one way, and two wire onto one or the other of the generators according to which of the remaining positions it is placed in. This allows you to stop one machine if desired either for repairs or inspection or to save steam, and still operate part of your lamps or of those motors connected between either outside wire and the neutral; those connected across the two outsides cannot be operated. If you desire to lessen the original cost as much as possible, you can leave out this break-down switch, in which case you can slightly simplify and cheapen your main generator switch equipment by putting in one triple pole instead of the two double pole. You will note that in a 2 generator 3 wire system, the machines never being in parallel, there is no need to provide for any equalizer connection. For running a parallel you can use two triple pole switches or else two double pole and two single pole; in the former case you must of necessity close positive, negative and equalizer connections simultaneously; in the latter by wiring the positive and equalizer to the double pole switch, and the negative to the single pole, you get the effect of the series winding in the machine being thrown in before its armature is connected to the circuit. By this means you are able to put the second machine in with less disturbance to the line voltage, which is sometimes very marked if the triple pole system be used, especially if the machines are heavily compounded. An exception to the above is sometimes made in the case of large machines, especially when of low voltage and situated some distance away from the switchboard, in which case the equalizer switches are placed on a pedestal one beside each machine; the equalizer bus bar running in as short a manner as possible, direct from generator to generator, and not going to the switchboard at all. Where the machines you are handling are a large size, it is sometimes considered desirable to make switches single pole, with or without barriers between them, this to prevent the chance of short circuiting when opened under heavy load, which is always present with a double pole switch to a greater or less extent. This change is irrespective of the service being two wire or three wire, and of the number of generators.

"Student," Montreal: What is the difference between a recording and an indicating wattmeter.

Ans.: The recording meter, as its name indicates, records or registers the consumption for energy which has taken place since it was put into the circuit; deducting from the reading at any given instant the amount registered at the last time it was read gives you the amount of energy reckoned, in watt hours, consumed in the interval. You will note that a watt hour being the power represented by a consumption of one ampere of current, at a pressure of one volt, for a period of one hour, or any other value of any or all of these factors whose product is one, the instrument does not give any indication of what has been the maximum or minimum current or voltage, nor the number of hours during which power was used—it simply gives the product of the three factors directly in watt hours. The indicating watt meter is like the ordinary ammeter, only instead of showing the number of amperes on the machine or circuit to which it is attached, it takes into account the voltage as well, and reads the number of watts being consumed at any given instant. Both instruments have this in common, that, when connected to alternating current circuits, they take account of the power factor, and record the true watts, not the volt-amperes; the former is less than the latter if the power factor of the circuit varies from unity.

"Enquirer": Would you kindly tell me the difference in loss of power factor for lighting purposes between a 133 cycle and 66 cycle generator, if it takes much more power on the water wheels, which is the power we use. The power is in the centre of our business extending about two miles either way. I wish to put in a few motors, and would be pleased to get all the information possible before doing so as to the loss in the different cycles of machines. I may say we have the 133 cycle generators now in use and quite a few motors. So would not wish to change unless there is quite an advantage; our business is mostly light. The time was so limited at the convention that such questions as above would not have been noticed as being too simple for such topics as came up.

Ans.: The difference in the power factors of a 133 and a 66 cycle lighting system is not of any practical or commercial importance; theoretically the latter will have a somewhat higher power factor and a somewhat less line drop, other conditions being equal, but except in extremely large plants the differences would not be large enough to be material. There is one point, however, that it may pay you to look into, and that is, that the transformers for the lower periodicity will usually cost more than the others. If you are considering the installation of motors the matter is different, as there are but few makers who have a 133 cycle motor to offer, and then only in a very limited range of sizes. It is to be regretted that at the recent convention in Quebec the time for the discussion of subjects like this was very limited, but we must differ from your statement that they would not have been noticed; they are very much to the point and would have afforded profitable ground for discussion.

"R.H.," Hamilton: I have a number of transformers on hand off a multiple arc system. They are S. K. C. 1000 watt, 1000 volt to 50 volt. Can I use them on the incandescent circuit by putting them on the same pole and connecting the secondaries in series? Our system is 1040 volt primary, 104 v. secondary.

Ans.: Yes, these 1000 to 50 volt transformers can be used in pairs this way, the primaries in parallel and the secondaries in series, to give a 100 or 104 volt secondary, without any difficulty.

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Reduced Price for Current

THE action of the New York Edison Company in reducing the price of electric current has a peculiar interest for all central stations, for upon the price at which current can be profitably sold will depend in large measure the expansion of the electrical industry. The reduction in question applies to arc and incandescent lighting, and is from a maximum price of 20 cents per kilowatt hour to 15 cents, or 25 per cent. The new schedule is as follows: 15 cents for first and second hours; 10 cents for third and fourth hours; 7½ cents for fifth and sixth hours; 5 cents over six hours. It is estimated that the average charge under the old rates was about 10.5 cents per kilowatt hour, so that an average of about 8 cents should be reached under the new scale. This price should greatly encourage the use of the electric light. Coming at a time when nearly everything else is advancing in price, the reduction will doubtless be the more highly appreciated by the consumers.

Steam vs. Water Power.

THE proposed installation of steam plants by one or two Canadian electrical companies heretofore using water power exclusively has revived interest as to which class of power is most satisfactory. In one instance it would seem to have been decided to provide the required power by a steam plant rather than by increasing the water power installation, which was at one time under consideration. There are still to be found advocates of steam power, especially for lighting purposes. While for motors water power is almost universally satisfactory, as much cannot be said for lighting, owing to the difficulty of securing perfect regulation and the serious results consequent upon a shut-down. The defect in regulation is usually attributed to the turbine, the governor not being capable of preventing the fluctuations. It has been suggested that something might be done to overcome the difficulty by placing a regulator on the alternator, so that only a certain amount of current would pass into the fields. Another point in favor of steam plants is their greater reliability, especially when compared with water power where the current is transmitted over a great distance. With the latter the danger of accident applies to the power house, transformer station and pole line. These are some of the reasons why leading electricians are not unanimously agreed that it will be found profitable to transmit Niagara power to Toronto.

Telephone Competition.

THE city council of Spokane, Washington, has refused a competitive telephone franchise to a local company. The decision was reached after exhaustive inquiries from other cities in the United States, and following the presentation of a petition from telephone subscribers, representing six hundred telephones, protesting against a dual system. A very strong letter on the subject was received from Mr. George M. Hoag, city electrician of Cleveland. He characterizes the experiment of competition in the telephone business in that city as a public calamity, claiming that over five thousand subscribers have instruments from both companies. The results are briefly summarized by him as follows: "The streets are encumbered with many poles that would be unnecessary if we had only one company; the present users of telephones are paying probably $175,-

000 or $200,000 per year more in rentals than they would with one system. There is the inconvenience of looking through two directories instead of one to find subscribers' names; many small investors and some larger ones have made investments which have not up to the present time proved desirable, resulting in unpleasant combinations much to be regretted." While there is much to be said both for and against competition, the peculiar nature of the telephone business places it in the class where competition is not desirable. It is much better to aim to so control existing companies that the public will be amply protected than to encourage the organization of opposition concerns.

Electric Fires.

THE danger of fire resulting from electric wires has been so grossly exaggerated by the press that the Insurance and Finance Chronicle, of Montreal, taks up the defensive side of the question as follows : " Electricity is experiencing the tendency of mankind to make anything a scape-goat that is available and cannot retaliate. Mysterious fires nowadays are commonly attributed to electricity, just as in earlier days all manner of mysterious visitations of sickness, accident and other calamities were attributed to witchcraft. The poor witches, so-called, could not prove their innocence, so neither can electricity, so it is being charged with most fires whose origin is mystery. The Electrical Bureau of the U. S. National Board of Fire Underwriters have issued a report on electric fires in the last quarter and fires so classed without evidence. The report states that "Numerous fires reported as due to electricity have, upon further and more reliable investigation, been found to have been due to other causes. Of these a $65,000 loss was due to spontaneous combustion in a pile of hair and packing material. A loss of $165,000 occurred in the celluloid room of a factory as the result of overheating celluloid on a softening press. A $4,000 loss resulted by overturning a candle while storing away goods. An $18,000 loss in a hotel was attributed to a defective flue. Other fires attributed to electricity were found to be due to an overheated smokestack, a leaky gasoline lamp, spontaneous combustion in oiled canvas, a gas heater, burning shellac in a bake oven, and an overheated furnace pipe. Reports were received from inspection departments aggregating $1,601,047, supposed to be due to electricity, but they are not included in this report, as the causes could not be definitely proven as electrical, principally because the fires destroyed the conclusive evidence of their origin."

The corporation of Durham, Ont., may install an electric light plant.

The ratepayers of Milton, Ont., defeated the by-law to purchase the electric light plant.

The sales of Westinghouse transformers have more than doubled in the past six months, and the transformer building capacity of the Westinghouse Company has been largely increased to meet the demand for O. D. and Type "N" Transformers.

SIMPLE HOTEL TELEPHONE SYSTEM.

Mr. Percy M. Brown, of Toronto, sends to the American Electrician the accompanying diagram representing a simple telephone system adapted for operation in connection with single-call hotel annunciators, concerning which he says:

The system is the central-energy system, but in order to simplify the apparatus and circuits, separate batteries are used for ringing and talking. The talking battery has a common-return wire extending to all of the stations, and the gas or water pipe system of the building is used as a return for the ringing battery. The diagram represents circuits for six stations or rooms, the instruments for these being indicated at the right-hand side of the engraving. In all cases T indicates a transmitter and R a receiver.

The switchboard arrangement is extremely simple, consisting of a single connection plug at each end of each cord circuit, and a one-spring jack for each station. The diagram shows the connections for a single-cord circuit and the central operator's set. A combined listening and ringing key of the rocking or oscillating type, similar to those in general use, is employed. The key is thrown to the left, as stated in the engraving, for ringing, and to the right for listening in. Each circuit, of course, has a ringing and listening key and choke coil, one terminal of every choke coil being connected to the talking battery wire, b. The operation is as follows :

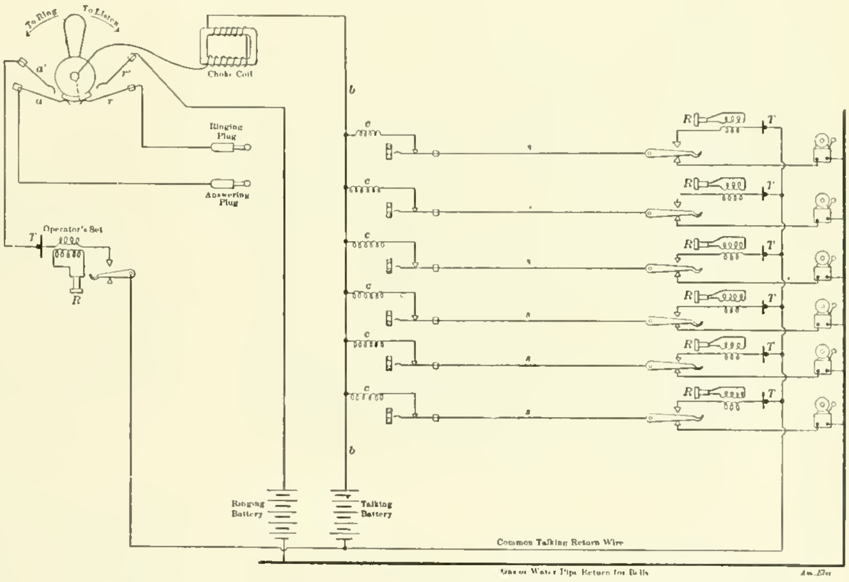

DIAGRAM OF CONNECTIONS FOR SIMPLE HOTEL TELEPHONE SYSTEM.

In order to call up a room, the central operator inserts the ringing plug in the proper jack, pushing the jack spring away from its contact and thereby disconnecting the service wire, s, from the coil c, which is connected to the talking battery wire, and at the same time connecting the service wire, s, to the ringing spring, r, on the ringing and listening key. Throwing the key to the left then connects the wire, s, of the desired station to the ringing battery through the springs, r and r¹, and rings the bell in the distant room. Then reversing the position of the operator's key and substituting the answering plug for the ringing plug in the jack puts the central telephone set in connection with the called station. Removal of the receiver at that station allows the hook-switch to change the connection from the bell to the transmitter circuit, as usual, and conversation is then carried on by means of the common talking battery. When two stations are talking to each other, they are connected in the usual fashion by the two plugs of a cord circuit and the springs, r and a, on the operator's key; the metal segment on the key, which forms a bridge between the two springs, is connected to one terminal of the choke coil. This is necessary in order to permit the use of a common talking battery.

The system is open to the disadvantage that the central operator after calling up a station cannot listen in except by reversing the ringing key and changing the plugs in the jack, but as telephone service in a hotel of ordinary size is not heavy, this is not serious; no difficulty has been experienced on this account with an experimental installation recently put in by the writer. A convenient feature lies in the fact that by throwing any ringing and listening key to the left without inserting any plugs in the jacks, the bells of every room will be rung simultaneously, as this connects the ringing battery through the choke coil to the wire, b b, which is in connection with all the individual service wires through the coils, c, and the jack springs. This feature permits a fire alarm signal to be transmitted to all of the rooms without any manipulation other than the simple throwing over of one ringing key.

LIGHTNING PROTECTION AND THE STATIC INTERRUPTER.*

By Mr. Percy H. Thomas.

It has sometimes been stated that everything in nature somehow or other serves a useful purpose. It may be, however, somewhat difficult for practical electrical men to see much of use in lightning. They usually much more clearly realize the damage and inconvenience which it causes them; but, however this may be, we cannot alter the conditions, and lightning must be forestalled. The problem is certainly a very difficult one, for sensitive apparatus is to be protected from extremely violent disturbances, greatly exceeding in tension the normal strains which are contemplated in the design of the apparatus; and, furthermore, protection must be secured without interrupting the normal operation of the system. It is necessary to separate the extremely high tension electric energy of lightning from the useful current at the moderate voltages of commercial circuits. Fortunately this may be accomplished with nearly complete success. It must be frankly confessed, however, that occasionally damage will result even with the very best available protection.

A stroke of lightning from the clouds usually follows some clearly defined path or paths in its discharge, causing violent destruction of nearly everything in its way; and in addition to this local violence, it also electrically disturbs the whole neighborhood. Like the cannon ball, which causes a great commotion in the air for some distance around as it passes, so lightning stirs up every electrical conductor within a considerable distance, causing a tendency for it to spark to other objects. Fortunately, in commercial lighting and power circuits, it is usually only these induced or secondary effects with which we have to deal, for lightning rarely strikes a line directly. The western cyclone is supposed to take up light bodies, such as straws, and give them such high velocity that they are able to penetrate boards. The secondary effects of lightning, which are in the form of waves occurring both in the ether and in all exposed wires, have some of the characteristics of these straws. They represent a comparatively small amount of energy, but are very sudden or abrupt in their nature, and produce extremely severe local concentration of strain. One of these secondary electrical waves passing along a straight wire makes comparatively little demonstration, as it meets little opposition; but if this wave finds a coil in its path, rather than flow around the turns of the winding, it will produce a strong tendency to jump across. Such waves have all the characteristics of the discharges obtained from frictional machines, and together with all other disturbances of a similar nature which occur in commercial circuits, may be defined as "static." An outline of the more common causes of static waves will be given in another part of the paper.

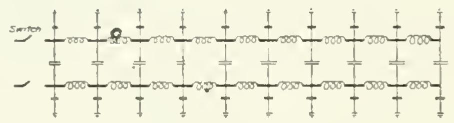

Fig. 1 Showing method of illustrating capacity and inductance in a Transmission Line

GROUND AND SHORT CIRCUITS.

Experience has shown that the injuries to electrical apparatus caused by lightning are generally of two sorts — First, "grounds," caused by the passage of sparks to earth, and, second, "short circuits," caused by the jumping of electricity between the turns of coils. All persons who have had much dealing with electrical apparatus are familiar with the thought of a "ground" resulting from lightning, since lightning is supposed at all times to seek the earth. In fact, the "ground" is older than the lightning arrester; but many do not recognize the fact that lightning may cause short circuits between turns of coils, as well as "grounds," even when not passing to earth. Such a possibility is shown by short circuits appearing in coils of a generator or transformer in such a location as to make it practically certain that no electricity has passed to earth. The explanation of the manner in which short circuits are caused and the description of a new type of apparatus devised by the writer to protect against such short circuits, form the principal object of the present paper.

ELECTRO-STATIC CAPACITY IN HIGH TENSION APPARATUS.

This power of lightning disturbances to cause short circuits arises in the fact that all parts of an electric system, including the generator and transformer winding, lines, instruments, etc., are to some extent electro-static condensers, and consequently before any part of the system can be raised to a particular potential, it must receive a charge proportional to this potential.

A high tension transformer coil has, comparatively speaking, quite a large electro-static capacity, since it has a considerable surface exposed to the low tension coils and to the core, and since it is separated from them only by a thin wall of insulating material. This capacity is greater the thinner the insulation between high tension and low tension coils and the greater the area of the surface of the copper. Similarly with generator coils, and in fact all kinds of apparatus.

Consider the charging of a high tension coil in a transformer when the voltage is being slowly raised. Each turn of the coil adjacent to the low tension winding, or the core, on account of its electro-static capacity subtracts a certain amount of electricity from the current which is passing, to form its charge. As the voltage rises, each turn continues to absorb the charge so that the current at the end of the coil farthest from the generator is less than that at the nearer end, since some electricity is abstracted at each turn. The amount of electricity thus withdrawn from the useful current is in commercial circuits usually very small in amount except on high voltage systems. In such systems the charging current, which flows to an open circuited line from the bus-bars, simply represents the sum of these small charges. In the case of the transmission system the line wires require nearly all of this charging current, leaving a small amount only for the transformers and other apparatus.

On the other hand, when the voltage of the circuit is gradually falling to O, all the electricity that has been stored in the electro-static capacity of the various parts of the system is given back to the circuit and the load current increased somewhat. The amount of these small charges on the line and apparatus, in other words, the charging current, depends solely upon the voltage of the circuit, and not upon the actual load current flowing. The total current in the line at any instant is the sum of the current taken by the receiving apparatus at the sub-station and the charging current.

LOCAL CONCENTRATION OF POTENTIAL.

Let us consider further the case of raising the voltage on a high tension coil, either of a transformer, generator or motor. As already stated, each turn on the surface of the coil must have its own charge, but the charges for the turns farthest from the source of current will arrive at their destination last, since they must flow through the other turns of the coil. Since a certain amount of time is required for the passage of the current around these turns, if the voltage be raised very quickly, the more remote parts of the winding will be charged up somewhat later than the nearest.

To make these explanations clearer, we may compare the coil to a long rubber tube wound up like the coil and filled with water, the whole being immersed in a tank of water. If, now, a current of water be started in the tube, no change occurs in its dimensions as long as the pressure within remains the same as the pressure outside, but if the pressure within the tube (which corresponds to the high tension voltage) be increased over that in the external liquid (whose pressure corresponds to earth's potential) the tube stretches to a certain extent and a certain amount of water is withdrawn from the current passing to fill the increased space (this corresponds to the electric charge absorbed by the wire with an increasing voltage). If the internal pressure be removed from the tube, it will contract and the water which had been originally withdrawn from the current flowing when the tube was distended will now be returned exactly as the stored electric charge is restored to the circuit when the voltage is removed.

To return to the effects of lightning. As already described, the result of a lightning stroke occurring near a line, which it does not, however, actually strike, is to cause waves of static electricity to pass along the line in both directions. These electric waves are extremely abrupt and travel with nearly the speed of light, that is, about 186,000 miles per second. When one of these waves passing along a wire reaches a lightning arrester, it usually causes the arrester to discharge by momentarily raising the potential of the line. If the lightning arrester be adequate it will prevent a serious rise of potential above the earth and will protect the apparatus from grounding. Suppose, however, for a moment, that there is no lightning arrester on the line, and that the apparatus connected is so perfectly insulated from the ground that no electricity passes to earth

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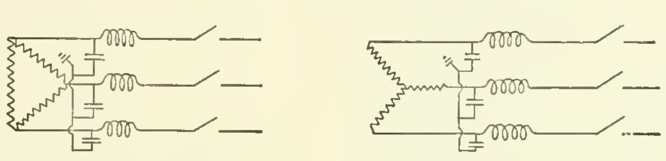
* Paper presented at the Canadian Electrical Association Convention, Quebec, June 1902.

Under these conditions, when the wave reaches the machine or transformer coil, the potential of the terminal of the coil will be very suddenly raised; but on account of the inductance of the coil (which corresponds to the inertia of the water in the tube of our illustration) for an instant no electricity can flow to the inner turns of the coil to charge them. Consequently, for this instant, until the inertia of the coil, so to speak, is overcome, a large difference of potential exists between the terminal of the coil and the inner layers. This strain may be a great many times larger than the normal electro-motive-force impressed on these turns by the generator, and will then have a very strong tendency to break down the insulation between the turns. If such a break does occur and a spark passes through or over the insulation between the inner and outer coils, the static wave causes only sufficient electricity to pass to charge up the electro-static capacity of the inner turns This in itself will cause only a very small spark nearly, or quite invisible to the eye, but if it occur at a moment when there is a considerable electro-motive-force impressed upon the coil by the generator, the momentary breaking down of the insulation may start a permanent arc, which will be maintained by the power of the generator. This phenomena is very similar to the starting of an arc in the gaps of the lightning arrester by the static discharge from the line.

It must be remembered that a static spark between turns of the transformer or generator coil does not by any means necessarily cause a short circuit; for if such a spark occur at a time when the generator E.M.F. is near its zero point, no arc will follow: in fact, usually the generator is not able to maintain an arc across a few turns, as their voltage is comparatively small. Other conditions, as well, may prevent a short circuit. Many repetitions of the static spark in the same spot, however, even without current from the generator, will cause a deterioration of the insulation, and a short circuit may result subsequently as a consequence of this injury. In such a case the short circuit will very likely occur at some time other than that of a lightning discharge.

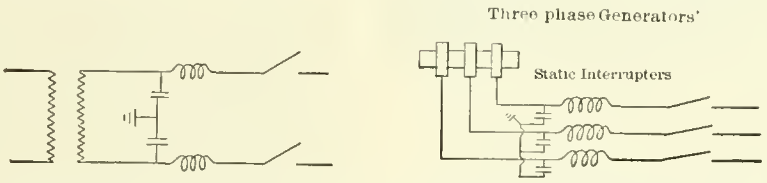
The characteristic of the static waves produced by lightning, which gives them power to puncture insulation between turns, is their abruptness, for the more suddenly the potential of the terminal of the coil is raised, the shorter the distance to which electricity will have penetrated to charge up turns when the maximum voltage at the terminal is reached, and the fewer the turns of the coil upon which this voltage will be impressed. If the terminal of the coil be raised or lowered slowly, comparatively speaking, as by the generator in its normal operation, no appreciable strain is produced.

Fortunately, every thunder-storm does not cause internal static sparking in apparatus in every plant, with consequent short circuits for protective apparatus, is usually quite effective, but in all cases where such protection is not provided, strains on the insulation will be produced as already described. Such strains may or may not cause injury, according to the strength of the insulation. With well-insulated apparatus on low voltages, there is little danger of a break-down, for experience has shown the necessity of providing a normal margin of safety between the turns of coils in transformers and generators (probably largely on account of difficulties that have previously resulted from static). In fact, the insulation between adjacent turns of a large high tension transformer whose normal difference of potential is perhaps 100 or 200 volts, will often fail to break down at 10,000 volts.



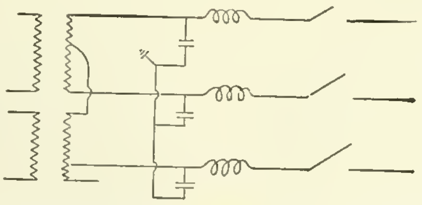
Three Static Interrupters Protecting Three Transformers Connected in Delta.

Three Static Interrupters Protecting Three Transformers Connected in Star.



Two Static Interrupters Protecting One Transformer.

Three Single Pole Static Interrupters Protecting a Three-phase Generator. Single-Phase and Two-Phase Generators are Protected by Two and Four Single Pole Static Interrupters Respectively, Connected in a Similar Manner.



Three Static Interrupters Protecting Two Transformers Connected for Three-phase High Tension and Two-Phase Low Tension Circuit

FIG. 2.—DIAGRAM SHOWING ARRANGEMENT OF STATIC INTERRUPTERS PROTECTING GENERATORS AND GROUPS OF TRANSFORMERS.

EFFECT OF DISCHARGE OF ARRESTER.

Up to this point, the question of the effect on the insulation of the coils of the discharge of an arrester to ground has not been considered. The primary function of the arrester is to discharge the line freely when the latter's potential rises abnormally. The most effective means for accomplishing this is, of course, the air gap, or series of air gaps between line and ground, but the arrester must as well prevent arcs being formed in the gaps by the generator after the discharge. The free discharge of the line can be best accomplished, except in special cases, by a series of non-arcing metal gaps, but as this type of arrester in operating practically reduces the line potential to zero instantly, the terminal of coils connected to the line will also be reduced to zero instantaneously, and the same sort of strain is produced as in the case of the secondary lightning wave, except that in these cases the terminal is suddenly dropped to zero potential instead of being raised. The difference in potential between the terminal and the inner layers is independent of whether the potential of the line is raised or lowered. Therefore, an arrester which is extremely free in its discharge of the line will successfully prevent strains to ground but may at the same time cause some strains between layers tending to cause some short circuit strains. Practically this matter becomes of importance only on high tension circuits.

An arrester which does not ground the line quite as quickly, but is still able to prevent a serious rise of potential above the earth, is better for high voltage than one with a perfectly free discharge path. The use of series and shunt resistances in the "Low Equivalent" arrester, is for the purpose of attaining this result as well as increasing the non-arcing power of the arrester. Further discussion of the discharge of the line by an arrester, which involves some very interesting points, cannot be given in the limits of this paper. Before proceeding further, it will be well to summarize briefly.

SUMMARY.

The most usual result of a lightning stroke in the neighborhood of an electric circuit is the production of secondary static waves traveling along this circuit away from the locality of the discharge. When one of these waves encounters a transformer or generator coil, it abruptly raises the potential of the terminal, and during the period while charging current is flowing to the inner turns of the winding, the potential of this wave will be impressed upon the outer turns alone, which may thus be subjected to a strain very many times greater than that normally impressed upon them. The harmful effect of these static waves is due to their suddenness, which is especially characteristic of lightning.

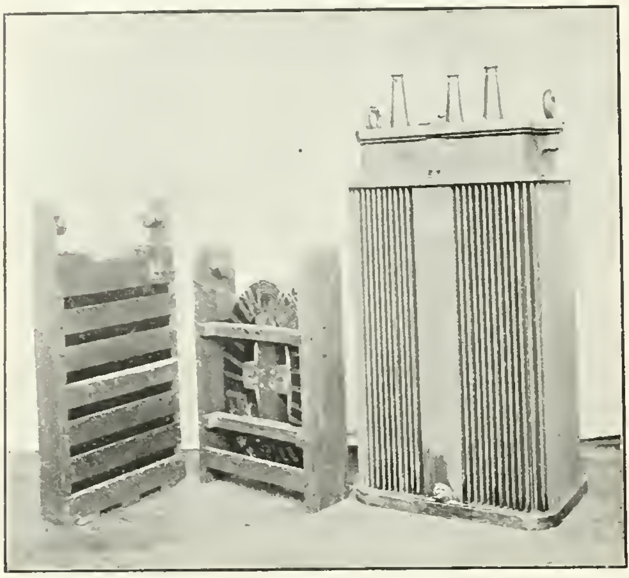


Fig. 3.—Coil, Condenser and Case for Static Interrupter.

Grounds in windings, as well as short circuits, may be caused by the excessive potential of such static waves, and apparatus should be protected by lightning arresters with a sufficiently free discharge path. If, however, the momentary grounding of the line due to the discharge of the arrester is very sudden, a certain strain will be produced between the turns of the winding near the terminal. When lightning strikes a line directly, however, which catastrophe fortunately rarely occurs, if the location of the stroke be distant from any apparatus, the lightning will soon leave the line again and reach the earth, probably over a pole. The only disturbance, then, actually reaching the apparatus will be a severe static wave, similar to the secondary waves of lightning already described. If the line be struck close by, however, the apparatus is pretty certain to be injured.

OTHER CAUSES OF STATIC STRAINS.

Other phenomena beside lightning can produce abrupt static waves in electric circuits with their consequent strains on coils; in fact, in some cases these other causes are more troublesome than the lightning itself. Such a state of affairs exists only in very high tension plants. Any cause which produces an abrupt change of potential at the terminal of the transformer or generator coil will cause a strain in its insulation. This may or may not be accompanied by a strain to ground.

The commonest causes of dangerous static waves aside from lightning are, grounding of circiuts; short circuits on lines; charging a dead transformer from a live line; charging a dead line from a live transformer; parallel lines out of phase; disconnecting an unloaded transmission line or cable from a live circuit, etc.

1. Grounding a Line.—If a live wire becomes suddenly grounded, its potential at the point of ground becomes zero practically instantly, and a static wave is started in the line in both directions, which brings all points on the line in succession to zero potential as they are reached by the wave, and finally the terminal of any apparatus containing coils which may be connected to the circuit. This sudden drop of potential gives evidently the condition necessary to cause a strain. In this case of the grounding of the line, however, no increase of strain is brought on the insulation to ground. In the case when one wire of a line becomes grounded, the other or others will receive full potential above the earth. This may mean that the unusual voltage will cause a ground on one or the other of the line wires, which will in turn cause a strain on the insulation between turns of the coils connected to this wire, but this time twice as great as before, since the potential change is numerically approximately twice as great.

2. Short Circuit between Two Lines.—When a short circuit between two phases or legs of the circuit occurs abruptly, as by the breaking down of an air gap, the result, so far as static strains are concerned, is the same as though both lines were grounded at the same instant. A strain is thus produced in the apparatus connected to both lines.

3. Charging a Dead Transformer from a Live Line.—This operation is severe on the transformer insulation, for when one of its terminals has been connected to the first line wire and the whole transformer has assumed the potential of this line, the closing of the second line switch changes one terminal of the transformer to the potential of the second line. This is an extremely abrupt change, and causes a severe local concentration of potential.

4. Charging a Dead Transmission Line.—The result of charging a dead line at full voltage is to momentarily drop the terminals of the raising transformer to zero potential, since the electro-static capacity of a transmission line is usually very great in comparison with that of a transformer. This sudden momentary drop of the potential has very much the same effect as the discharge of arresters, or grounding of lines. Of course the potential of the line and the transformer are immediately raised again by the generator, but there will always be a momentary drop, as the generator, on account of its inductance, cannot supply current instantly. As an exception to this case, it must be noted that if the transformer be already supplying other high tension lines so that there is a reservoir of electricity to draw from, then the potential of the live line, and transformer will be dropped only part way to zero, by connecting on the new lines, and a less static strain will be produced.

5. Paralleling out of Phase.—This is similar to short circuiting, as described above, so far as static effects are concerned, except that as two generators are involved, the voltage may be double the line voltage.

6. Disconnecting a Light Loaded Transmission Line or Cable.—There is one interesting case in whch static strains may be produced that is easily overlooked. If a transmission line or cable be disconnected from a high tension busbar, the charging current of the line or cable is interrupted at the instant that the E.M.F. of the busbars is at a maximum, since at this time the current is zero, and there will also be zero potential between the line and the busbars from which it is being disconnected; therefore, as the current drops out, the line is left with a charge which it will retain for a short time, on account of its high insulation, but the busbars' potential, following the generator, reverses, and when a negative maximum is reached, if the switch is not sufficiently opened, this generator voltage will cause the re-charging of the line. At the next zero point of the wave the current will drop out again, and we shall have the same operation repeated until the switch is finally opened wide enough to prevent the generator voltage from re-charging the line. Thus, the condition of disconnecting a light loaded line evidently may produce the same static strains in apparatus as connecting the line in the first place. Except for lightning, whose maximum possible voltage has no definite limit, these static strains arise originally from the normal voltage of the generator, and in any circuit will be in proportion to this voltage, comparatively high on high tension circuits, and comparatively low on low tension.

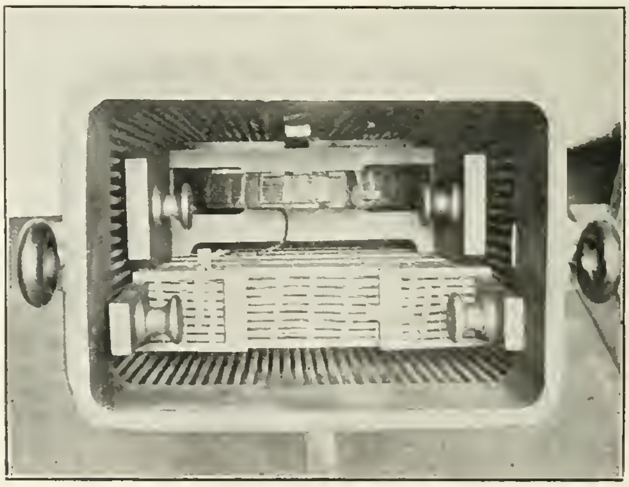


Fig. 4.—Internal View of Interrupter Without Oil.

So far, it has been assumed that those phenomena causing static disturbances which depend directly upon the E.M.F. of the generator, have occurred at the phase of the E.M.F. wave most favorable for the production of the static strain; that is, near its maximum. Of course, they will usually occur at other phases of the E.M.F., and the resulting strains will usually be correspondingly less. In fact, any particular form of disturbance must usually happen a good many times before it is certain that it has occurred at a time most favorable for causing static strain. This is one of the facts that make it unusually difficult to trace the effects of static disturbances. All the disturbances designated as static are extremely rapid in comparison with the normal frequency of the generator, so that the line potential must be considered constant while they are taking place.

It will be well to emphasize the fact that in most cases static injuries and sparks between turns leave almost no visible trace and give no sign of their presence until it is too late to avoid short circuit. Therefore, every precaution should be taken to avoid all operations known to produce such strains.

It is usually connecting transformers or circuits rather than disconnecting, and switching out light loads rather than opening heavy circuits, that produce the severest static strains.

CHARGING WAVE IN TRANSMISSION LINE.

The present paper does not aim to discuss fully electric waves in transmission lines, which is a very intricate subject, but probably it will be of considerable interest to consider briefly the manner in which a long transmission line is charged when suddenly connected to a high tension busbar rigidly maintained at a certain potential.

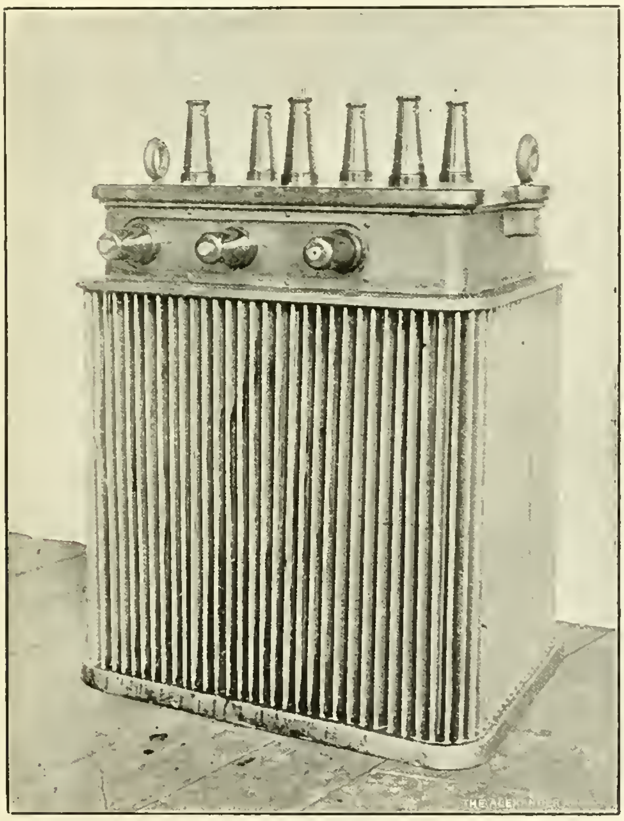


Fig. 5.—Case for Triple Pole Static Interrupter.

It must be assumed that the transmission line is long enough so that its inductance will be considerable, otherwise the line will act as a simple conductor. Such a long line may be assumed to be made up of a series of small choke coils and conductors connected in series and distributed as shown in the Fig. 1.

When such a transmission line is suddenly connected to a high tension busbar, a wave is started along the line. This wave passes along at a perfectly definite rate, keeping its original form pretty closely until the end of the line is reached. Here, as the wave can go no farther, it piles up against the end, so as to speak, and is reflected backward toward the source, keeping its form and raising the potential of the line as it progresses just as if it had not been reflected. When the electric wave first passed along the line, it left the line fully charged to busbar potential, and in a steady state. When it turns back after reflection at the end of the line, it again raises the potential an equal amount, so that this time after the passage of the reflected wave the line is left charged to double potential. When this wave reaches the busbar again, its energy is there absorbed and another wave started similar to the first, but reversed in sign, which reduces the line to busbar potential again. This second wave, which is really a "falling" wave, passes to the end of the line and is in turn reflected back. On its backward journey, it reduces the line potential from the busbar potential, where the wave left it on the outward journey, to zero, so that when the busbars is again reached, the line is momentarily in its original condition, entirely uncharged, except at the busbar end. This second wave is absorbed by the busbars, and a third wave started exactly similar to the first, and the charging operation is repeated, and so on indefinitely. The phenomena as described assumes that the line has zero resistance, and that there are no losses of energy. If the line has resistance, as of course it always has, the charging wave is formed in the same manner, only is continually growing weaker as it passes along until it finally dies away and the line gradually comes to rest at normal potential. Thus, the final result is that the whole transmission line passes from zero to double busbar potential forward and backward in very much the same way as a condenser suddenly charged through the choke coil.

PROTECTION OF APPARATUS.

The manner in which lightning and other static disturbances may cause short circuits in apparatus has been pretty fully treated. The most important part of the paper from the point of view of the operating engineer remains, viz., the description of devices for the protection of apparatus from such strains as are dangerous. As already stated, the operation of the arrester in relieving the line of excessive strains to ground will not be further treated.

CHOKE COIL.

Ever since the first introduction of lightning arresters on power circuits, choke coils have been used to some extent as auxiliaries. These choke coils are the type of apparatus which is adapted to protection against static waves, for in passing through a choke coil, a static wave is smoothed or flattened out and its abruptness reduced. As the choke coils frequently used have not always been designed with the definite object in view of protecting particular apparatus from the local concentration of potential, they have often been inadequate. A sufficiently powerful choke coil in the path of a static wave will render the wave practically harmless, but if a less powerful choke coil be used, it may not reduce the severity of the wave materially, and little benefit may be derived. Another important point—different designs of apparatus require different choking power in the coils which protect them, for the static wave must be much more completely smoothed out to relieve from strain a transformer coil of many turns than one of few. This follows, for charge can penetrate into a coil of few turns much more quickly than into one of many.

STATIC INTERRUPTER.

For moderately high voltages, effective choke coils can be constructed and should always be used, but the choking power of these coils should be at least approximately proportional to the apparatus to be protected. But it will be found in most cases in very high tension circuits that if a choke coil powerful enough to prevent dangerous strains be placed in the line, that this coil will seriously interfere with the normal operation of the circuit, or that it will get hot when carrying full load, or have an excessive cost. In other words, such a coil will be found impracticable.

It becomes, therefore, very desirable to find some other way of accomplishing the same purpose without excessive cost or interference with the normal operation of the line. The "static interrupter" is such an arrangement. It consists of a condenser, in connection with a comparatively small choke coil, the condenser being connected between line and ground. The line connection is made between the apparatus to be protected and choke coil. With this arrangement, a comparatively small coil may be used, for the condenser, by absorbing a large part of the charge which passes the coil, multiplies its choking effect. It is possible by increasing the size of the condenser to get almost any desired degree of protection. The multiplying power of the condenser, so to speak, depends upon the relation of its capacity to the electro-static capacity of the outer coils of the transformer or generator that is being protected. Since the electro-static capacity of the transformer is very small, that of the interrupter may be many times larger and yet not be of serious moment in the normal operation of the line. For example, in interrupters actually designed, capacities are rarely as high as .01 M.F.

To summarize, the static interrupter consists of a choke coil and a condenser, forming together a device for effectively rendering harmless the abrupt waves resulting from lightning and similar causes. The protective power of the interrupter must be proportionate to the design of the apparatus to be protected. This adjustment need not, however, be very close. As the interrupter has a choke coil in series with the line, it must be suited to carry a certain current, and as it contains a condenser, must also be adapted to a definite voltage and frequency. As both coil and condenser experience an energy loss when in use, the case of the interrupter must be so designed as to properly dissipate this heat.

LOCATION OF STATIC INTERRUPTER.

Since switching is one of the prominent causes of static strains in such high tension circuits as require the use of static interrupters, the apparatus should be so placed that no switching shall occur between the interrupters and the transformer or generator to be protected, usually in their leads. In some cases, however, such an arrangement leads to an unnecessarily large number of interrupters. For instance, when two or three, or more, transformers are operated in a group on polyphase circuits, interrupters may usually be placed in the leads of the groups instead of in the leads of the individual transformers. In this case no switching is permissible within the interrupters except under the following conditions.

1. Circuit breakers or fuses may be open under heavy loads or short circuits, since the arc formed prevents any change of potential at the terminal sufficiently abrupt to cause serious local concentration.

2. High tension windings of transformers may be thrown in and out of service at will, provided their low tension windings are excited from the same source as the high tension busbars. Such switching causes no change of potential at the terminal. For example—if it is desired to cut out one transformer from the group of three connected in delta, cut out the high tension winding of the one to be removed from circuit. Though this causes the transformer to drop its load, no material change is made in the potential of its terminals, since the low tension winding is still in parallel with the other transformers. The low tension switchings may now be opened.

In connecting back this transformer to the delta, the low tension should first be connected to the other transformers, which will magnetize the iron and cause the high tension to assume line potential, though it will not of course be carrying any load. The high tension switchings may then be closed without causing any change of potential, and the transformer will pick up its share of the load. On the other hand, if the high tension winding be connected to the busbars first, we have a violent raising of the potential of the terminals. The general arrangement for static interrupters in commercial circuits are shown in Fig. 2.

The static interrupter provides protection against local concentration, but is not expected to provide protection against strains to ground. Of course, as an interrupter (and in fact a lightning arrester choke coil as well) delays as well as smoothes out static waves, it will give an arrester properly placed on the line side of the coil more time to discharge, and will thus indirectly help to prevent strains to ground; but, in general, the static interrupter performs an entirely different function from the lightning arrester. It is supplementary, not a substitute.

CHARACTERISTICS OF COMMERCIAL INTERRUPTERS.

Some of the characteristics of actual interrupters designed by the author for commercial service may not be out of place. In these interrupters, which are illustrated in Figs. 3, 4, and 5, choke coils are wound of several turns per layer and are very heavily insulated; they are wound without iron core.

Condensers are built up with thin copper plates and sheets of insulating material, consisting of special treated fullerboard, the whole being immersed in oil. There are ventilating spaces provided for oil circulation, to prevent dangerous rise of potential in the interior of the condenser. Three leads are brought from the interrupter, one for the line, one for the apparatus and one for the ground connection. The cases are provided with the oil level indicators, by which the depth of oil in the case may be determined without removing the top. The relative location of coil and condenser and the connection between them, are shown in Fig. 4.

HIGH TENSION CONDENSERS.

As comparatively little has been published of the characteristics of high tension condensers, some of their most important peculiarities will be of interest.

1. The charging current, temperature being constant, is proportional to the voltage and to the frequency and to the capacity of the condenser. The capacity (or more accurately, specific inductive capacity) in condensers for interrupters, increases with temperature, though not very fast. Ordinarily an increase of from 10 to 20 per cent. may be expected for a rise from 20°C. to 70°C.

2. The electric energy stored in the condenser measured in watt-seconds or joules, is one-half the product of the capacity in farads, and the square of the voltage. One watt-second equals 11-15 ft.-lbs. The maximum energy actually stored in the condenser of an interrupter for protecting a modern sized 30,000 volt transformer, would be something like three joules = three watt-seconds = 2.2 ft.-lbs.

The statements following refer to condensers of the type used in the static interrupters referred to; other types may have different characteristics.

3. There is a very considerable heat loss in the dielectric of condensers when subjected to alternating voltages somewhere near the safe limit of the insulating strength. These losses may be made to greatly exceed one watt per cubic inch without attaining a voltage high enough to break down the condenser. The loss is approximately proportional to the square of the voltage, and increases very fast with the temperature. If the loss in the condenser is one watt per cubic inch at 20°C., it may be three or four watts, or more, at 80°C. This is at once a very surprising and important result that must be carefully noted in the use of condensers, for a condenser which has a comparatively small loss when running in a cool place may, if transferred to a hot atmosphere, have its loss so increased by the higher temperature as to rapidly heat up and break down. On the other hand, as noted above, the specific inductive capacity which determines the charging current, not the loss, of the condenser, does not vary nearly as rapidly with the temperature, although increasing somewhat.

Condenser losses are very greatly increased by the presence of moisture in the insulating material. A very small amount will cause a dangerous increase. It is consequently very important not to expose high tension condensers to the atmosphere, unless they are thoroughly moisture proof.

The subject of static disturbances is most fascinating, and destined to be of considerable importance on high voltage plants. On account of her numerous water powers, Canada will have a large number of such plants, and her engineers should profit by a careful study of the subject. Much can be gained in relieving the apparatus of static strains without sacrificing the quality of the commercial service, by the careful planning and operation of the plant. In this connection, it will be well to caution engineers against the danger of improperly conducted over-potential tests on apparatus. The specifications of the American I.E.E. for testing the insulation of apparatus provides for the use of a spark gap in connection with the apparatus to be tested, which is expected to break down and prevent any increase in voltage above the testing limit. It is readily seen that such a breakdown of the gap causes the worst condition for producing static strains between turns of coils in the apparatus, as not only is the change of voltage extremely abrupt, but the amount of the strain is much beyond the voltage of normal operation. In all cases where such a spark gap is used, a very high resistance or powerful choke coil should be placed in the connections of the gap to prevent its causing a sudden change in the potential of the terminal of the apparatus by breaking down. In fact, any sparking which may occur in temporary wiring when special high voltage tests are being made upon apparatus may cause injury to insulation.

In conclusion, the writer wishes to remind the Association that there is much to be learned about static strains, and that the only way to determine the full bearing of this subject on commercial electric systems, is by analyzing and comparing the experiences of as many plants as possible, under as many different conditions as may be. Anyone who has an unusual experience with static disturbances will help along the general knowledge by bringing the matter in detail to the attention of someone experienced in such occurrences. A danger well understood is more than half avoided. What we need is more discussion and reports of more actual experiences.

REGISTRATION FEES FOR LIGHTING COMPANIES.

OTTAWA, July 30th, 1902.

Editor CANADIAN ELECTRICAL NEWS:

DEAR SIR;—The regulations governing electric lighting companies have been amended in respect of registration fees. Formerly the classification was that all companies having installations of 1,000 incandescent lamps and under paid a fee of $10 per annum and those having installations of 1,000 lamps and over paid $25 per annum. The new classification, which is as follows, makes a reduction in the fees of smaller companies amounting in all to about two thousand dollars annually:

"The registration fee for all companies having an installation of five hundred incandescent lamps and under, five dollars ($5.00) a year, all companies having an installation of over five hundred and not exceeding two thousand incandescent lamps, a fee of ten dollars ($10.00) a year, and all companies having an installation in excess of two thousand incandescent lamps, a fee of twenty-five dollars ($25.00) a year.

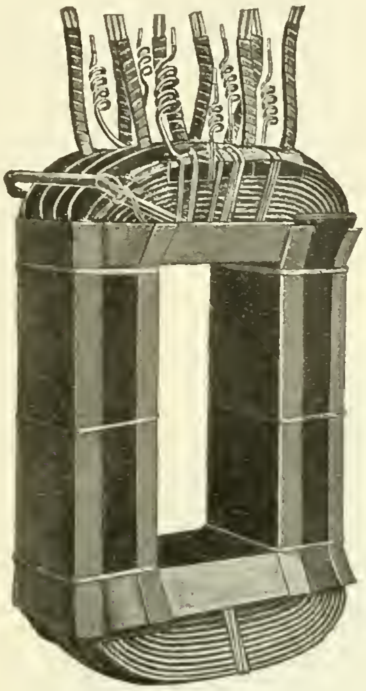
For the purpose of this regulation each arc lamp shall be deemed equal to ten (10) incandescent lamps.

Each company registering shall be entitled to a test of voltage and a comparison of their measuring instruments with the Departmental standards once in each year free of charge."

Yours very truly,
O. HIGMAN, Chief Electrical Engineer.

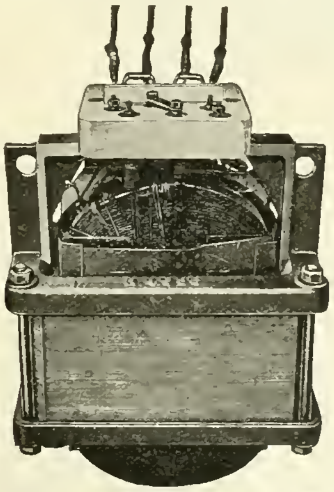
THE WESTINGHOUSE TYPE N TRANSFORMER.

As the Westinghouse Company was the first to introduce the practice of winding for two primary and two secondary voltages, it is not surprising that this company has taken another step forward in the same direction by bringing out a transformer provided with additional voltages. The new transformer, Type N (shown herewith), is not intended to replace the company's well known O.D. transformer, but rather to fill the demand for a reliable transformer, which, provided with additional ratios of transformation, has a greatly extended range of voltage. The shell type of construction is used as in Westinghouse O.D. transformers and in the company's large high voltage transformers up to 100,000 volts and 2,730 kilowatts capacity.



Assembled Coils of Westinghouse Type N Transformer Showing Special Coil Feature.

The primary winding of the Type N transformer is divided into equal parts, which may be connected in series or in multiple. The secondary winding is divided into four equal parts, which may be connected in series, series-multiple or multiple. The primaries of all transformers are wound nominally for 1,000 and 2,000 volts. Transformers from ½ to 25 K.W. inclusive are wound for nominal secondary voltages of 50, 100 and 200 ("Class 200"), and those from 2 to 50 K.W. inclusive for voltages of 100, 200 and 400 ("Class 400"). The secondary voltages in each class of transformers can be varied to suit either the varying line voltages of an extensive transmission system, or to give special voltages from standard circuits. All transformers are arranged for three wire secondary distribution, and the secondary coils cross-connected to give equal voltages on both circuits, even with large unbalanced loads.



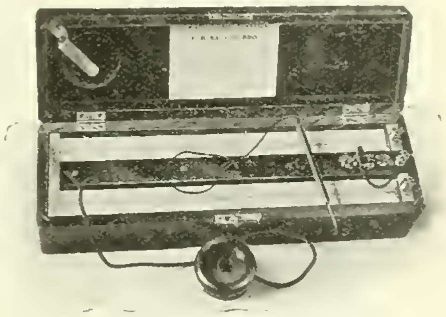
4 K. W. Westinghouse Type N Transformer.

SAGES' DIRECT READING OHMMETER.

To fill the demand for an instrument capable of quickly measuring resistance in much the same way that a portable voltmeter measures volts and a portable ammeter measures amperes, Mr. C. E. Shedrick, of Sherbrooke, Que., has placed upon the Canadian market Sages' direct reading ohmmeter, an instrument for the purpose of measuring resistance which is portable, direct reading, accurate, simple and cheap.

This instrument, shown in the accompanying illustration, depends upon the well known Wheatstone bridge principle, and therefore the strength of the battery in no way affects its accuracy. It consists of two wires of special alloy, which are stretched over suitably graduated scales. Several independent resistances are provided, which are connected in the proper way by means of a plug which will fit in any one of the four holes provided for it on the right hand end of the instrument. Thus there is only one plug in circuit, and the possible error from poor plug contact is very remote. Two binding posts are provided, across which the resistance to be measured is connected. These posts are marked xx. A telephone receiver suitably connected to the device is held to the ear, and the little key K is pressed shut with the thumb. This closes the battery circuit. A stylus is provided, which is held in the hand in much the same manner as a pen, and this is touched at various points along the wire until a point is found at which no click will be heard in the telephone receiver.

To begin the measurement, the first step is to touch each of the two outer binding posts; two clicks will be heard of different intensity, and the post which gives the faintest click is on the scale on which the point of silence will be found. The brass connecting block at the end of this scale is then touched with the stylus, and the end which gives the faintest click is nearest to the point of silence. In three touches of the stylus therefore the desired point is located on a given quarter of the total scale. This quarter is rapidly traversed by the stylus, and the point of silence is soon found. After a few trials ten or twelve seconds will suffice for this operation. The scale under the point of silence is read directly, and gives the desired resistance in ohms.



Sages' Direct Reading Ohmmeter.

The simplicity of the instrument is obvious; there are no pivots to break, no large number of plugs to loosen, no multiplicity of binding posts. The telephone receiver as a detector renders it independent of levelling, stray magnetic fields, and of vibration.

The battery contained within the instrument consists of six small dry cells and can be renewed at any time by the owner at an expense of less than two dollars. The battery is guaranteed to last six months with continuous use.

Mr. Shedrick would be glad to send prices to persons interested in this instrument.

SPARKS.

The electric lighting system of Amherstburg, Ont., is to be extended.

The Vancouver branch of the Canadian General Electric Company is now located at 527-529 Granville street, in a new building just completed by them.

E. Leonard & Sons, of London, Ont., have secured the order for three Peerless self-oiling engines of 90 horse power each for the Montreal Board of Trade building.

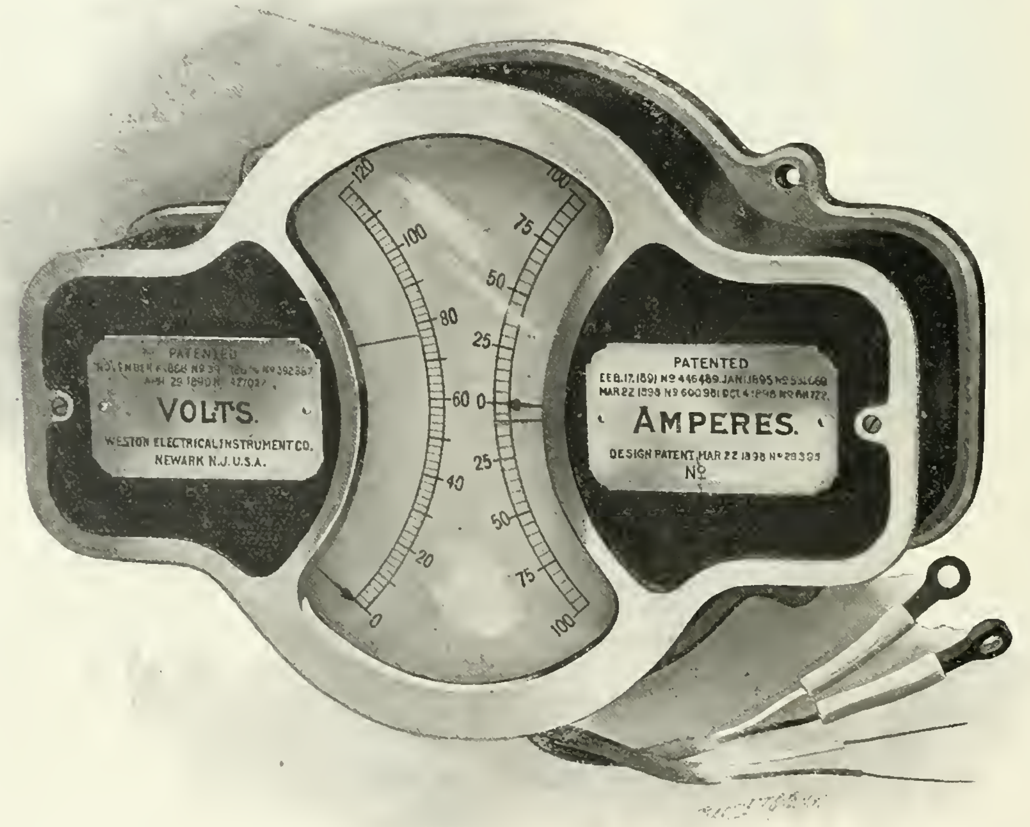
The Standard Light & Power Company is about to install a steam heating plant in Montreal. The electric plant is now situated on Chenneville street, from which it is proposed to run steam pipes underground to the consumer.

The new engines for the Halifax Electric Tramway Company will be obtained from the Providence Engineering Company, of Providence, R.I., and will give a total capacity of 1,500 horse power. The Canadian General Electric Company will supply the electrical apparatus, the Babcock & Wilcox Company, of London, Eng., and Montreal, the boilers, and the Jones Underfeed Stoker Co., of Toronto, the stokers.

DUPLEX INSTRUMENTS.

A new product has been placed on the market by the Weston Electrical Instrument Company, of Newark, N.J., in their duplex instruments. These instruments are called "duplex" because they contain a voltmeter and an ammeter in one case. For some purposes this combination, it is claimed, will be found much more useful than two instruments in separate cases. For instance, in many cases where practically simultaneous readings of current and potential difference are to be made, these instruments will be found more convenient to use on account of the close proximity of the scales and indexes, and they will also be found specially useful in all cases where space is limited and compactness is a necessary or desirable feature.

At present the Weston Electrical Instrument Company make two models of this type of instrument, designated R and T. Each has for some uses specially desirable features not found in the other. In model R the two instruments are enclosed in a neatly designed and nicely finished waterproof aluminum case, which closely surrounds the operative parts of the instruments. The use of an aluminum case secures the minimum weight. This model is well adapted for outside use, where the instrument is exposed to the weather. They are particularly suitable for use on an electric vehicle on account of extreme lightness, compactness, and freedom of danger from injury by water, snow, moisture, or dust and dirt. The instrument and moving parts are so constructed as to be able to bear without injury the constant vibration to which such instruments are subjected while in use on vehicles.



Model "R" Duplex Instrument.

These model R instruments are not well suited for use in cases where powerful external magnetic fields exist, since such fields would disturb the accuracy of their indication. They are, however, exceedingly well adapted for use on small switch-boards and especially on motor-starter switch-boards, where they will be found to render very valuable service in indicating the power used in driving single machines or groups of machines.

In the model T the working parts are precisely the same as in model R, except that the scale is larger, the case is made of cast-iron and is not waterproof, and does not closely surround the working parts of the instrument. This type is well adapted for use in small isolated plants and for all cases where the existence of powerful external fields would render it impossible to use the R model. The function of the cast-iron case is to shield the instrument from external fields, and this it does in a most effectual manner.

The Westinghouse Electric & Mfg. Co. reports the sales of Westinghouse integrating wattmeters for the month of June to have been the largest in the history of the company.

Mr. Frederic Nicholls, general manager of the Canadian General Electric Company, has purchased an extensive property on Lake Simcoe, near Barrie, for the purpose of a summer residence, and with his family is spending the vacation there this year.

MOTOR CARRIAGES IN SOUTH AFRICA.

South Africa seems a promising field for the sale of auto-motor lorries. According to the "British and South African Export Gazette," mechanical motors are slowly but surely winning their way to popular favour in South Africa. The Table Bay Harbour Board have recently placed orders for six steam lorries for use in the delivery of cargo from the docks, and the first of these to arrive has already made trial trips with, we believe, complete satisfaction. Kimberley citizens have likewise lately made initial acquaintance with these vehicles, the first of its kind seen there having lately been imported. An order for a number of motors will also be shortly forthcoming for Mafeking, while the South African Motor Car Syndicate, Durban, have just secured the approval of the Town Council to run a line of motors to Sydenham, Umgeni, and the South Coast Junction, which will be eventually extended to the whole of the suburbs and the outlying districts. Having previously imported their cars, the service is now probably in full swing. Doubtless these details, merely a few out of many, mark only the incipient stages of a coming big demand for motors, for if there is anywhere an opening for mechanical traction it is on the extensive roadways of the several colonies now badly served by ox-wagon transport.

The same authority also points out that there is now a growing demand for agricultural implements and machinery in that region. The use of agricultural appliances is also making its way among the numerous native tribes to the north of the Zambesi, and a very considerable demand has arisen of late. British manufacturers would do well to ascertain the exact nature of the wants in these districts.

"RENEWABLE" INCANDESCENT LAMP.

A "renewable" electric incandescent lamp was exhibited recently in England. It is an ordinary lamp of excellent make averaging more than the usual life, and with an efficiency of between 2½ to 3 watts per candle power. Its use certainly saves current, but that is, after all, its least advantage. Thanks to improvements under various processes, and more especially to the adoption of a very novel and ingenious mode of fastening the filament, says the Boston Transcript, the new filament can be fitted to the lamp, thereby saving the platinum, cap, bulb and wires, provided, of course, the bulb is unbroken. This can be done as often as needed. The result is that the lamps are renewed indefinitely at just one-half their original cost. All the user of a 5 to 25 candle power lamp, costing twelve shillings a dozen, has to do when it gives out is to send it to the company and they will put in a new filament and send it back as good as new, at a charge of twelve cents.

Mr. A. E. Edkins, inspector for the Boiler Inspection and Insurance Company, and Mr. W. J. Webb, chief engineer for the Lawlor Estate, will leave Toronto on August 20th on a pleasure trip to England.

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THE GOLDSTREAM-VICTORIA TRANSMISSION PLANT.

The British Columbia Electric Railway Company, Limited, which has developed the Goldstream-Victoria transmission plant, is a British organization, the directors being R. Horne Payne (chairman), F. S. Barnard, I. Horne Payne, K. C., A. C. Mitchell-Innes, G. B. Norton and Francis Hope, of London, England. Mr. J. Buntzen is general manager, with headquarters at Vancouver. The other officers of the company are R. H. Sperling, general superintendent, Vancouver; A. T. Goward, local manager, Victoria; G. M. Tripp, superintendent, Victoria; H. Gibson, superintendent of traffic, Victoria.

The company operate the electric railway systems in Vancouver, Victoria and Westminster, also the interurban line connecting Vancouver and Westminster. This description will be confined to the Goldstream transmission plant.

Previous to the present company being formed in 1895, the concern was known as the Consolidated Railway Company. The new company finding the steam power inadequate to met the demands, decided to utilize the water power of Goldstream, a mountain stream 13 miles from Victoria. The transmission plant, however, was not completed until 1898.

The water right is controlled by the Esquimalt Water Works Company. They deliver water to the power house gate valves at 285 pounds per square inch. This company has done some very excellent and substantial work, in building dams for three large storage lakes, and a balancing reservoir (see Fig. 1.) The reservoir is at the head of their pipe line, which is 7,920 feet long and 28 inches in diameter, rising to an altitude of 700 feet above the power house. During the wet season the lakes fill to their total capacity, and the storage is ample to tide over the summer months.

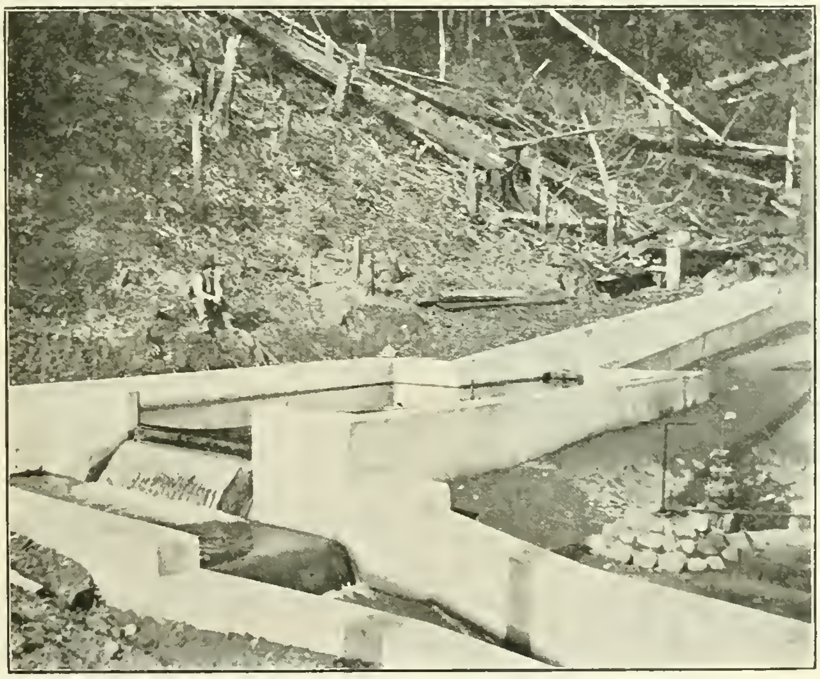

Fig. 1.—View of Tail Race, Weir Basin and Spillway.

The power house installation consists of two 600 horse power and one 900 horse power Pelton impulse water wheels (shown in Fig. 3), direct connected to two 360 k. w. and one 500 k. w. 60 cycle three phase Canadian General generators (Fig. 4.) Each machine has its own exciter and governor. The current is generated at 700 volts, after which it is transformed to 17,000 volts for transmission over the line to Victoria. Between each alternator and the set of raising transformers to which it is connected, are one alternating current volt meter (which is so arranged that it can be thrown onto either of the three legs), three ammeters, two integrating wattmeters, and two indicating wattmeters. There is also a switch to connect the machine busbars to the transformer busbars

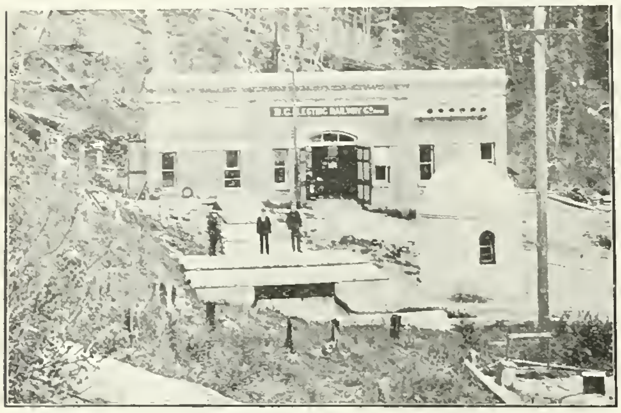

Fig. 2.—Exterior of Power House.

through a synchronizer. Between the raising transformers and the high tension busbars there are also, for each set of transformers, three single-pole double-throw 20,000 volt switches for connecting to either of the two out-going lines.

The accompanying illustration (Fig. 5) shows the nine raising transformers in their separate transformer room, together with high tension switches, blowers, and blower motors.

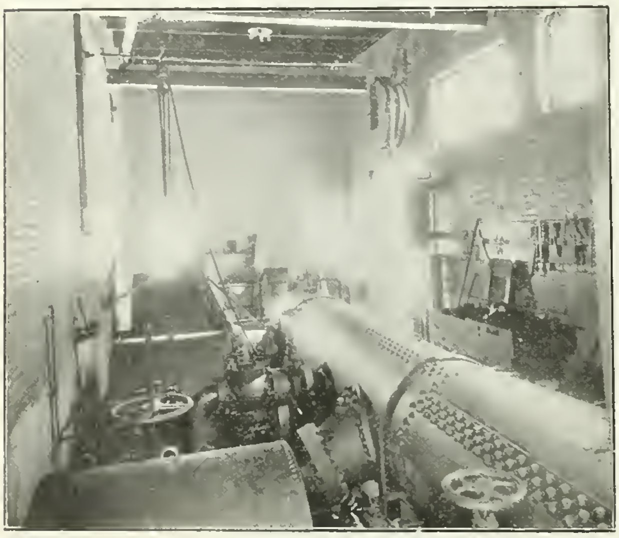

Fig. 3.—Wheel Room, Showing Three Pelton Water Wheels and Receiver.

The transmission line consists of six No. 4 B.& S. copper conductors mounted on 22,000 volt insulators. This line is built through a very rough and wooded country, a great number of the trees measuring 200 feet in height, with 5 foot trunks, and to ensure an uninterrupted service it was necessary to clear a right-of-way 300 feet each side of the pole line.

The sub-station in Victoria is equipped with one 300 k. w. 60 cycle three-phase rotary converter and three 125 k. w. lowering transformers. An additional 300 k. w. rotary-converter and four 125 k. w. lowering transformers have been ordered and are now nearly ready for operation. There are also six 125 k. w. lowering transformers for lighting purposes, with an additional four on order. The high tension switches and wiring in sub-station is similar to that at the generating station.

The company have also a reserve steam plant in the sub-station, to be used in case of accident to or failure of the transmission plant.

The company have in operation about 35,000 incandescent lamps, 50 Nernst, 50 commercial arc, and 100 motors of various sizes connected to their system. The business portion of the city of Victoria is fed from a three-wire secondary distribution using 25 k. w. transformers to lower the voltage from 1040 to 110 and 220 volts. For the outlying districts a primary voltage of 2000 volts is used. The railway consists of fifteen miles of track and twenty cars.

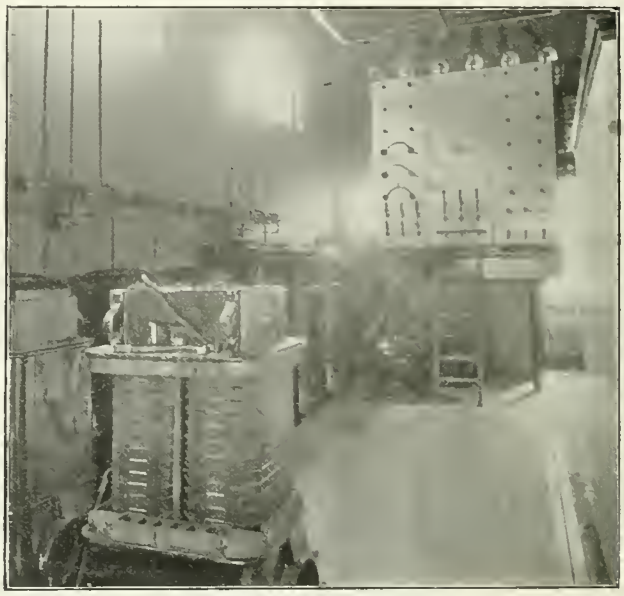

Fig. 5.—Step-up Transformers and H. P. Switches.

The company recently erected at Victoria a new car shed capable of housing forty cars. It is 240 by 160 feet, of brick, and equipped with all modern improvements. Exterior and interior views are shown in Figs. 7 and 8.

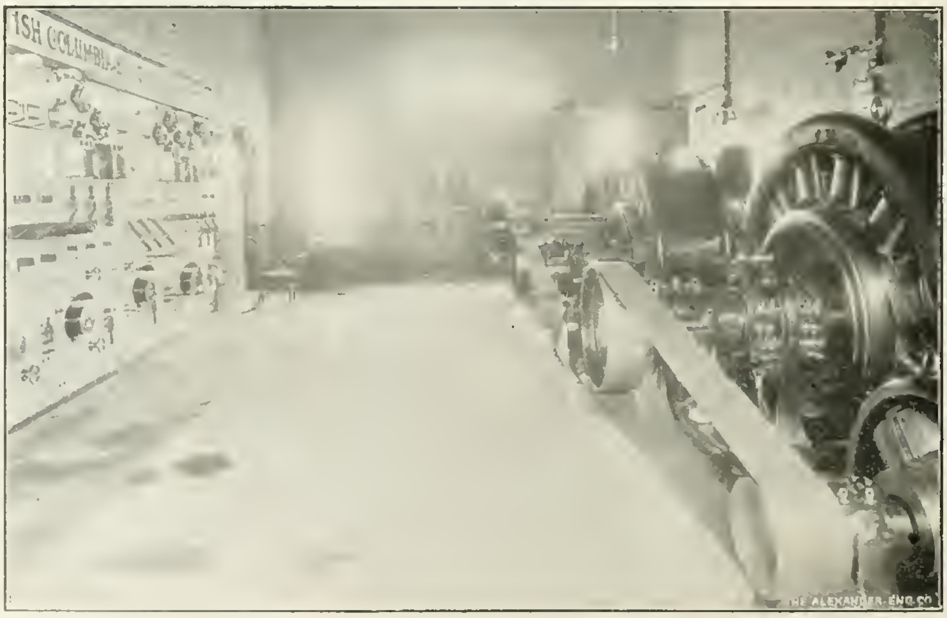

Fig. 4.—Generator Room.

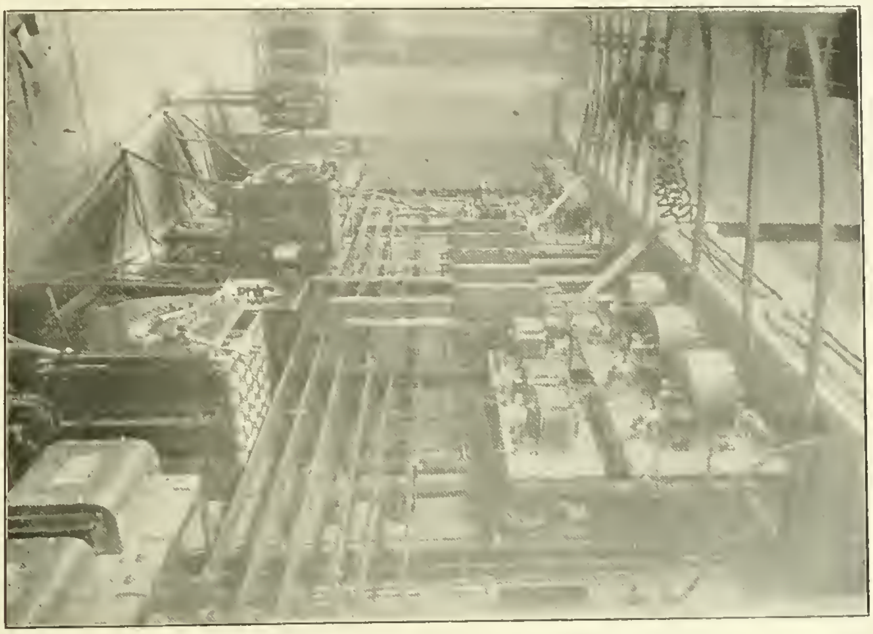

FIG. 6.—BACK OF LOW PRESSURE SWITCH-BOARD.

BEES IN A TELEGRAPH BOX.

A dispatch from Morristown, N. J., says: When A. P. Green, manager of the Postal Telegraph Company at Chester, climbed up to the cable box on top of a 50-foot pole in front of his office he was looking for trouble, but not the kind of trouble which he got. When he opened the box he found there a mass of buzzing bumble bees—"a million of them" is the way he expressed it. A swarm of bees had taken possession of the box and were filling it with wax and honey. Mr. Green slammed the door shut and got down in record time. He immediately reported the matter to headquarters, and now the officials of the telegraph company are trying to get some thick-skinned or fearless man to ascend the pole and fish out the bees and honey, for it is said that they have stuck the Chicago and St. Louis wires together.

TELEGRAPH LINEMEN.

A recent issue of the Toronto Globe contains an interesting sketch of the work of telegraph linemen. The Great North-Western Telegraph Company, it is stated, have over one hundred regular linemen in their employ. This number is largely augmented in the summer season, when the lines are given a general overhauling by the repair gang. The work required may be judged by the extent of wires and territory covered. The Great North-Western Telegraph Company have 18,000 miles of poles, 40,000 miles of wire, with some 1,800 offices throughout Ontario, Quebec, New Brunswick, Manitoba, and a section of British Columbia. The Canadian Pacific Telegraph Company have 42,000 miles of wire in operation in Canada and 1,100 offices. In certain remote localities along the lower St. Lawrence River, and in the North-west Territories, where private companies would hardly be justified in extending their lines, the Dominion Government have in operation somewhere in the neighborhood of 3,600 miles of wire and 184 offices. The total amount of capital invested in Canadian telegraphs may be roughly fixed at between six and seven million dollars, and the total wire mileage at somewhere in the neighborhood of 86,000. In respect of population it can truthfully be said that no country in the world enjoys a more extensive system of telegraphs than Canada. Scarcely a town or hamlet in the whole country but has connection by this means with the outside world.

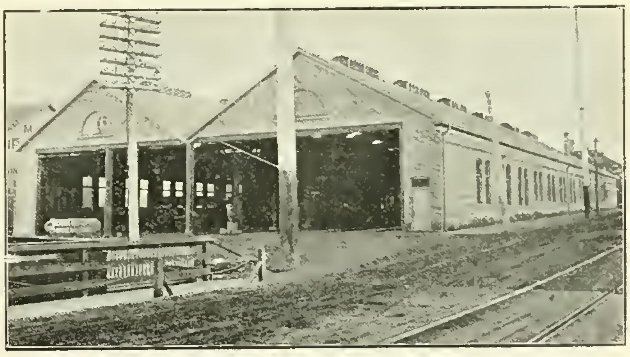

FIG. 7.—EXTERIOR OF NEW CAR BARN.

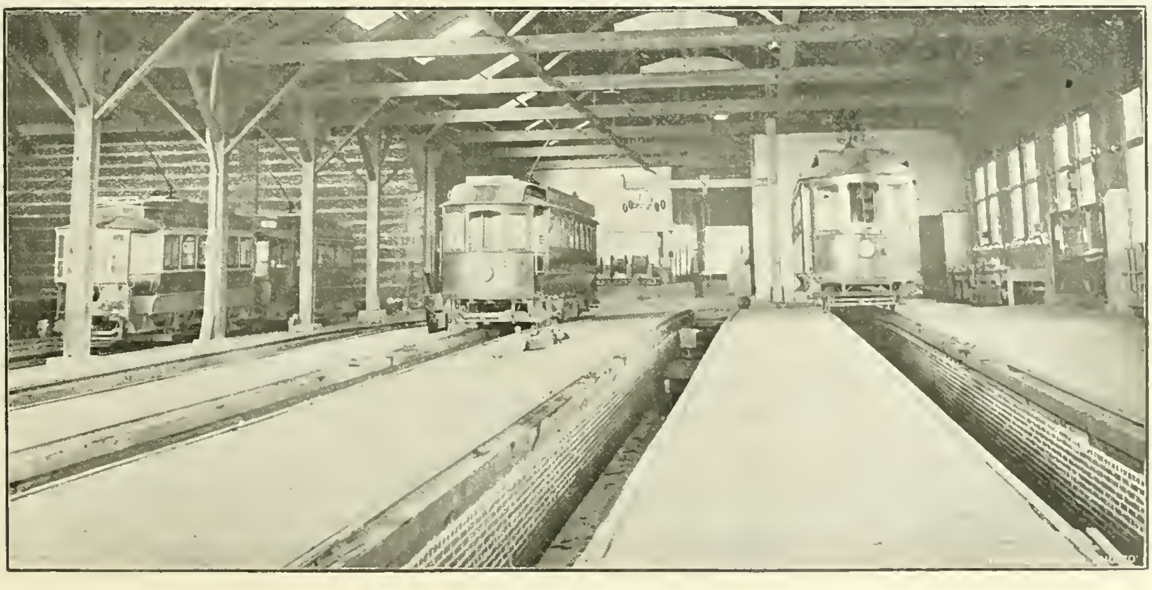

FIG. 8.—INTERIOR OF NEW CAR BARN.

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The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Metric System. FROM the Colonial Conference in London comes word of the resolutions which were passed calling for memorials to be presented to the proper parties in the British Government, requesting that they again take up the question of the Metric System, with the view to its adoption in England at no very distant date. This is the country which has stood out most strongly against a change in its methods and tables of reckoning and measuring, and if the advocates of a decimal system were successful in having it adopted throughout Great Britain, the balance of the world would forthwith follow suit, and with joy. The expenditure necessary to make the change complete would naturally reach into enormous sums, and the time required would extend into several years. In the meantime mistakes and confusion would without doubt be present to an appreciable extent, but on the other hand the benefits derived would come to the portion of everyone in the land; a very minor point, which comes home to all of us who have had occasion to handle English money, is the self evident superiority of the decimal coinage whose advantages we enjoy. Electrical men can further testify to the point when they consider the ease with which electrical power can be reckoned in kilowatts, using the decimal figures of 1,000, as compared with the time honored but nevertheless most inconvenient designation of horse power in watts, where the extremely unhandy number 746 has to be repeatedly used as multiplier and divisor. It is to be hoped that in this and many other proposed changes the work of the Conference will result in the adoption by the Mother Country of those ideas and systems which, while long recommended by other nations, have steadily been objected to by England.

Entrance of Suburban Roads. APROPOS of the negotiations at present being carried on by the Toronto Railway Company, the City of Toronto and the Metropolitan Railway Company with a view towards settling the terms on which the latter shall enter the city limits, one of the Toronto evening dailies recently devoted part of its space to calling upon the civic officials to protect the city against what, according to it, was likely to be a serious inconvenience, if not positive danger, to all those who use the city highways, namely, a third rail. It was claimed that a third rail would have to be laid wherever the Metropolitan cars were run, as it is a standard gauge road, while that in the city, through some curious mischance, is some two inches wider. While it is the privilege of the press to guard the civic interests, and to lay before the public all things likely to menace its well being, it is one of their first duties to make sure that they do not cry "Wolf, Wolf" where no wolf exists. The difference in the gauges of two inches would not allow of an extra rail being laid, and even if it would the attendant expense would be a most effectual deterrent, seeing that it would be necessary not only to put in the extra rail itself, but that new special work would be required at all intersections and turnouts, a truly serious matter. There are enough genuine obstacles in the way of a settlement, without the introduction of alleged difficulties to hamper matters, and it is to be hoped that all parties to the contract will recognize the great benefits which will accrue to all concerned when the various suburban lines now stopping at Toronto's gates are successful in arranging for running rights to the centre of the city, and work in harmony to that most desirable end. Toronto is almost alone, even among Canadian cities, in requesting that her citizens be put to the great inconvenience of transferring when they reach her boundaries, while across the border such a bar to the progress of both parties, the city on the one hand and the railways on the other, would not be tolerated for an instant.

Demand for Multi-phase Apparatus.

A FEW years ago all those plants installed for the purpose of lighting the smaller of our cities and towns were equipped, when alternating apparatus was selected, with single phase machinery, but latterly the trend has gradually turned the other way, and multiphase apparatus is coming more and more to the front. The present indications are that this movement will continue until the former will become almost obsolete. This change in practice is due to several courses; in the first place alternating plants which but a very short time past installed a single phase equipment, saying that their business was lighting and that no motor load was visible, are to-day bemoaning their inability to carry the day load of motors which has so quickly sprung into existence and is offering itself. "Once bitten twice shy" is an old adage, and based on it multiphase machinery is being installed to-day for lighting work only; if a motor business can later on be worked up, the apparatus is in the power house ready, without any changes whatever, to drive it. Again, recent improvements in various methods of compounding alternating current generators, compensating not only for a difference in actual current output, but also for the changes in the character of that output, that is, variations in the power factor of the load, which are inseparable from motor circuits, have made it comparatively easy, compared to what it was in the earlier stages of motor work, to maintain a steady line voltage, and has thus removed one of the greatest objections to the serving of both lighting and power from one set of bus bars. There is also another point to be considered, and that is that either a two or three phase machine can be loaded on one phase only to 70 or 80 per cent. of its total output, and the heating be no greater than if it were fully loaded, each phase with its proper share. The natural query is, why should one buy a 100 k.w. two or three phase machine when one of 70 or 80 k. w. single phase will carry the load, and the answer is: Owing to several well-known electrical laws, a given weight of copper and iron will, with the same heating, give 20 to 25 per cent. more output if wound multiphase than if single phase only, or in other words, a 100 k. w. multiphaser costs little if anything more than a single phaser of 70 or 80 k. w. capacity. Obviously the first machine, capable of equalling the latter in the latter's field, and of outstripping it in its own, is much the preferable one of the two.

Consulting Engineers

THE Canadian field for the consulting electrical engineer is gradually widening;, especially is this the case in the past few years, as water powers but a short time ago considered almost valueless have been one after the other developed and have proved good investments, but there is a regrettable tendency among many of our financial men to send across the border when in need of technical assistance. Surely this is a state of affairs not only much to be regretted, but one which a little reflection will show is quite unwarranted. There are a number of men in Canada who are in every way the peers of those across the line to whom much of the business goes. The men putting in electrical plants and hoping for a revenue from the profitable sale of their product, electric light and power, are dependent for their success upon the ability of their customers to in turn profitably dispose of their goods; why should they not give an example by spending their money in their own land, buying their engineering advice at home. The cry is often heard, "our men have not had the necessary experience." How are they going to get it if they are not given the chance? The argument savors too much of the system of condemnation first, the trial to follow. The matter does not end at this point either; if the erecting engineer come from our neighbors, the chances are that much, if not all, of the apparatus will be imported, and thus the Canadian trade gets another set-back. To the consulting engineers a word might be said. Their duties lie not so much in preparing a specification very minute in some details and slurring over some of the large and most important items, but in going over the local field and advising their clients the system and plant most suited to their requirements, the specifications being but little more than a statement or outline of the items required and the duties to be performed. The designing and manufacturing engineers are the ones to enumerate the guarantees and other details of the equipment they propose to furnish, the consulting engineer advising the purchaser on the true merits of the various points brought forward by each tenderer, and finally, after the contract has been awarded and the plant installed, making clear to all parties that the successful bidder has faithfully performed the terms of the agreement. Too often one sees great stress laid on a difference of one per cent. in the full load efficiency of a generator, when, taking into consideration those of the boiler and engine, or the water wheel, and the belting and shafting, the difference in the resultant plant efficiency is utterly and entirely negligible.

OUR BRITISH OFFICE.

Owing to increased British business, the publishers of the CANADIAN ELECTRICAL NEWS have established a branch office at 22 Great St. Helen's, London, E. C. Persons interested in the electrical industry are requested to avail themselves of the facilities thus afforded for securing information regarding the Canadian market. Our representative will be pleased to call personally in response to a request. Address, The C. H. Mortimer Publisihng Company, 22 Great St. Helen's, London, E. C.

LIGHTNING AND SYNCHRONOUS APPARATUS.

In answer to a query sent out by the National Electric Light Association as to what effect lightning will have on synchronous apparatus operated from transmission lines, Mr. C. O. Burrows, of Walla Walla, Wash., communicated that with single-phase apparatus lightning always causes step to be broken and generally burns out one or more coils of the generator. As a consequence of this the Walla Walla Gas and Electric Company has discarded single-phase synchronous apparatus.

QUESTIONS AND ANSWERS

"R. T." writes: Can you give me a receipt for making a black finish on brass articles, something that is easy to apply?

Ans.—Make a strong solution of nitrate of silver, and another of nitrate of copper, not quite so dense. Mix the two in about equal proportions and dip the articles in. Leave them there for a short time only, then heat until the desired degree of blackness is attained.

"Student," Montreal: What are the different voltages to be obtained from three transformers, on a three phase system, if I connect the primaries and secondaries in the different combinations of delta and Y? the primary voltage is 1,040, secondary 104.

Ans.—With primary and secondary both delta or both Y, the secondary voltage will in both cases be the same, namely 104; with primaries Y and secondaries delta the voltage is $\frac{1}{\sqrt{3}} \times 104 = 60.4$ volts; if the former be made delta and the latter Y the equation is then $\sqrt{3} \times 104 = 180.1$. When the primary windings are connected delta, the combined capacity of the three transformers is three times that of one, but when they are connected Y, the line voltage remaining unchanged, their capacity is but $\frac{1}{\sqrt{3}}$ or .577 times that of what it was before, these capacities being unaffected by the connections of the secondaries.

C. I. F. Marckton, St. Andrew, Scotland, writes: "I should esteem it a great favour if you could supply me with any information with regard to the insulation of 100 to 3000 volt aerial lines as used in Canadian towns and suburban towns. If any tests, especially life tests, on these lines have been made I should be glad to be able to obtain these. I should also be glad to have copies of the rules, if any, corresponding to the Board of Trade regulations in England."

Ans.—Canadian practice for the insulation of all voltages up to the highest you specify is to use weatherproof insulated wire mounted upon a double grooved double petticoat insulator made of glass, about four inches high, and three inches in diameter at its widest point, the pin, which is of oak, holding the lowest edge about 1½ inches from the cross-arm. We do not know of any life tests having been conducted, but it can be said that in most cases all the materials with the exception of the insulation on the wire will last until removed to make way for lines of larger capacity or a different location. Exceptions to the above would be cases where the line runs over open country, in which case the wire would most probably be bare; further, where heavy conductors such as 4/0 B. & S. cable or larger are used, it is often considered advisable to install a somewhat larger and stronger insulator, shaped to accommodate conductors of larger diameter. We are forwarding you two copies of the National Electric Code, being the rules governing the installation of electric apparatus as recommended by the National Underwriters' Association of the States and adopted by the Canadian Underwriters' Association. You will find in it detailed specifications for weatherproof wire. No 1902 edition of the Code has been issued, that issued last year being adopted in toto for this season also.

R. E. Smith writes: We have removed the armature of our 250 volt power generator for repairs, and have just got it finished, but it will not excite itself; can you tell me how to find out what is the matter?

Ans.—The trouble probably consists either in a cross in the winding or in having the wires connected to the commutator in a direction opposite to what they were before. We would suggest that you connect the two field coils, or if it is a multipolar machine, the two halves of the field, in parellel, then if a short circuit exists in the armature winding it will almost certainly show itself by heating of the coil concerned or by the burning out of the cross. If no trouble manifests itself when the machine is run in this manner, and it still refuses to generate, reverse the field connections, that is, interchange them on the brush holders. It is now practically certain that the generator will excite, after which the field coil connections can be restored to their original relations with respect to each other, leaving them reversed on the armature. If the machine is compound wound it will be necessary to reverse the series fields also.

"J. H.," Victoria, B.C.: Explain what is meant by working steam expansively, as in a steam engine.

Ans.—Steam is a water vapour or water gas, and may be taken, as far as this question is concerned, to have the properties of a perfect gas. Its properties will therefore vary inversely as its volume, and consequently if it is at a high pressure it will be capable of expanding until it has the same pressure as the atmosphere, if a vaccum is provided by means of a condenser, and by thus expanding it will be able to do work. To explain as clearly as possible what is meant by working steam expansively, as in a steam engine, take first an engine working with full steam pressure the whole length of the stroke. Then the work done per stroke is the pressure of steam on the piston in pounds multiplied by the length of the stroke in feet, and the steam is exhausted at nearly the same pressure as it enters the cylinder. Now, take an engine using steam expansively. The full pressure of steam is on for part of the stroke, and the work done for this part of the stroke will be the pressure of steam on the piston in pounds multiplied by the length of this part of the stroke in feet. The steam is then cut off, and the steam in the cylinder, instead of being exhausted at this point, is allowed to do more work by expanding and thus driving the piston the remainder of the stroke, and the steam is then exhaused at a much lower pressue than it entered the cylinder. It will thus be plainly understood that by working steam expansively you do not get the same amount of work out of an engine as if the steam was on full pressure the whole length of the stroke, but the amount of work got out of the same amount of steam is considerably greater. Thus less steam is required to do the same amount of work, and there is consequently a saving in fuel.

The Midland, Ont., Electric Light Company, have been offered $8,000 by the town for the purchase of their plant.

DEVELOPMENT OF ARC LIGHTING APPARATUS FROM 1810 TO 1902.

By W. D'A. Ryan.

[*]We will devote this evening to a review of Arc Lamp Development from 1810 to 1902, with a general consideration of Modern Arc Lamp Engineering. It will be quite impossible to do justice to such an exhaustive subject in a single evening's discourse, but I will attempt in a very general way, to touch upon a few of the most important points of development in the art, with a brief reference to limitations in modern design.

The year of 1800 marked the beginning of an era of unparalleled discovery and invention and is most memorable in the annals of Science.

It was in this year that Alexander Volta, Professor of Natural Philosophy at the University of Pavia, constructed the first Thermo-pile from which feeble currents of electricity were obtained.

Precisely 100 years ago this eminent scientist and philosopher produced the first flashes of electric light. His generating aparatus was not of sufficient power, however, to form more than a mere spark.

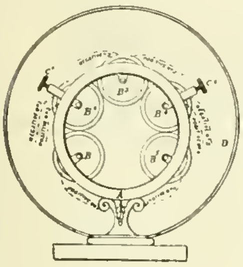
In 1810 he succeeded in forming a three inch arc. The current was obtained from a battery of 2,000 cells, which was installed at the Royal Institute about 1808.

The arc was established between two small pencils of vegetable carbon, commonly known as charcoal.

Sir Humphrey Davy was a man of pure science and he made no attempt at a practical application of his discovery, preferring to devote all his time to further scientific research.

While the famous experiment was repeated from time to time in various laboratories, many years passed before a practical application of the discovery was attempted; in fact, nothing worthy of note was done in this direction until after the invention of the Grove battery in 1836 and the Bunsen battery in 1842.

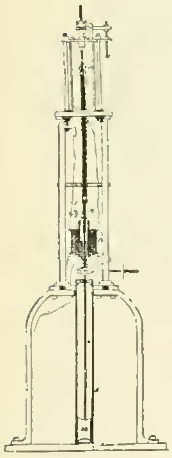
These chemical generators of electricity produced sufficient current to maintain a light for a considerable time, and the subject of electric illumination immediately merged from mere scientific interest to a matter of practical application, and from 1840 to 1860 many patents for arc lamps were taken out.



Wright.

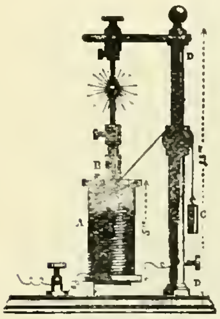
The earliest forms of lamps mentioned are the Duboscq and the Foucault. These were wonderfully sensitive and delicate and were never used outside the laboratory.

In 1845 Wright, of England, took out the first arc lamp patent. His lamp consisted of five disks of carbon which were rotated by clockwork, the arc being established by hand screws. It was a mere laboratory toy and had no practical value.



Staite.

In 1847 Staite patented a lamp in which the carbons were arranged vertically and the feed was governed by the strength of the current traversing the circuit.



Archereau's Lamp.

In 1848 Archereau of Paris produced a lamp having a soldnoid magnet. This lamp burned about $1\frac{1}{2}$ hours.

The following year Le Molt of France designed an improvement on the Wright Lamp. In his patent he claimed the means of rotating two disks of carbon and varying the distance between their peripheries. In the Wright lamp there was no means of the latter regulation. Le Molt also claimed the use of all kinds of carbonized material, especially gas retort coke, which was found to be greatly superior on the point of life and homogeneity to the vegetable carbon used by Sir Humphrey Davy.

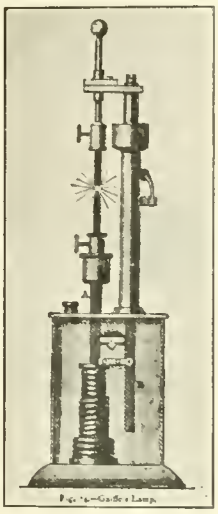
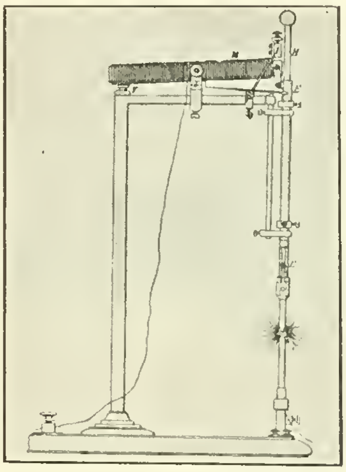
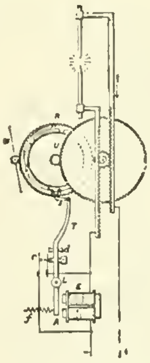


Fig. [illegible]—Gaiffe's Lamp.

In 1850 Gaiffe focusing lamp was introduced. The carbons were held together by a coiled spring instead of a weight as in the Archereau lamp. It burned about three hours on one carboning.

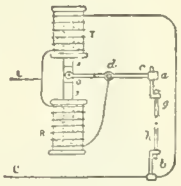


In 1852 M. J. Roberts of England patented a curious type of lamp which picked up against a stop and fed only on the interruption of the arc.

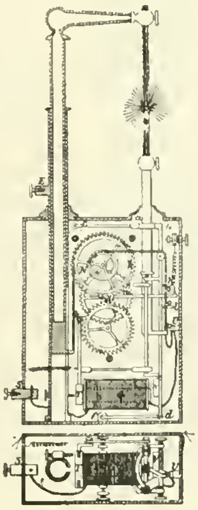


Siemens' Lamp.

Three years later (1855) Siemens patented a differential-rack focusing lamp. He also introduced a differential solenoid lamp free from gear trains and rack rods.



Siemens' Differential Lamp.



In 1857 Serrin took out his first patent on a magnetically controlled clockwork focusing lamp which had a life of about $3\frac{1}{2}$ hours.

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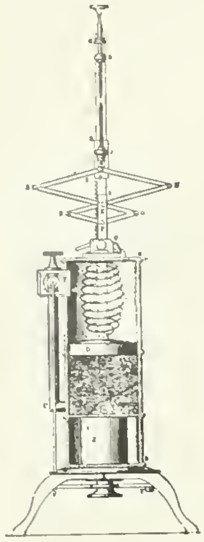
* Paper read at Twelfth Convention of Canadian Electrical Association, Quebec, June, 1902.



Margais and Duboscq.

In 1858 Margais & Duboscq introduced an arrangement which was ingenious rather than practical. An electro-magnet is located in the lower part of the lamp, where it acts upon a piston-armature floated in a cylinder of oil. The feed is affected by the attraction of the magnet for the iron float, which gives motion to a lazy-tongs carrying the negative carbon.

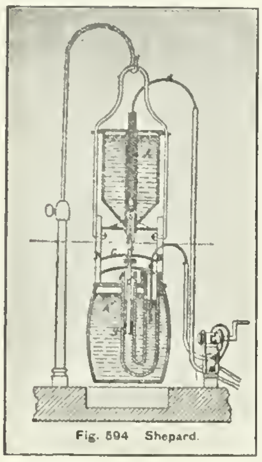
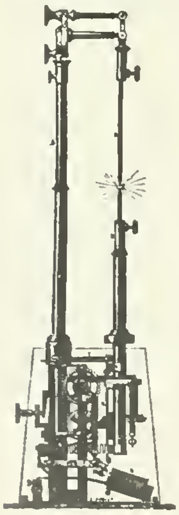


Fig. 594 Shepard.

During the same year (1858) E. C. Shepard of Westminister patented a so-called incandescent arc with mercury float control. The tubes carrying the mercury were cooled by a water jacket. This lamp has no practical value and I show it merely as an illustration of one of the peculiar types of early development.



Serrin (Suisse Model)

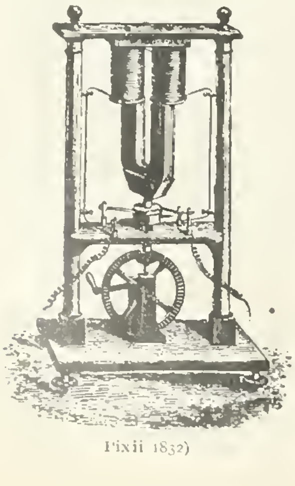
In 1859 Serrin improved his design of 1857 and brought out the 'Suisse Model', having a life of 12 to 16 hours, as compared to 3½ hours in the earlier lamp.

About this time inventors concluded that arc lighting did not have an extended field of operation principally owing to the many disadvantages and high cost of generating electricity by batteries.

During the period of repose which lasted 17 years the Suisse Model of the Serrin lamp was practically the only one which maintained an existence across the interval.

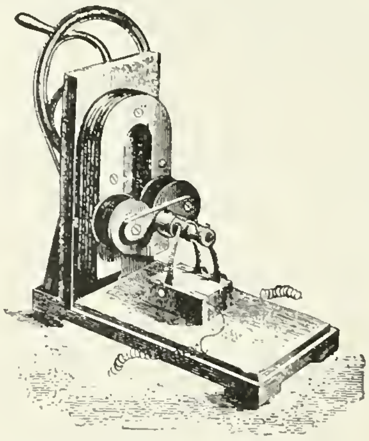
I will now take advantage of this period of inactivity to drop back a few years and review the discoveries and development which lead up to the generation of electricity from magnetism.

In July 1820 Oersted, a Dane, showed that a magnetic needle was affected by the proximity of an electric current. This was followed by Ampere and Arago, who demonstrated more clearly the counteraction between them. It remained, however, for Faraday, following in their wake, to show that a magnet would create an electric current by approach or retrogression from a bar of soft iron having wound around it a number of turns of insulated wire.



Pixii 1832)

In 1832, the year following Faraday's discovery, Hyppolite Pixii, at the Academy of Science, Paris, produced what was essentially the first attempt at moulding Faraday's discovery into such shape as to fulfill the requirements of practical application. This machine consisted of two spools of wire suspended from a suitable frame, and a permanent horse-shoe magnet mounted so that its poles could be revolved rapidly past the ends of the spools. A small two part commutator was attached to the shaft, which rectified the alternating current generated in the spools to a pulsating current flowing in one direction.

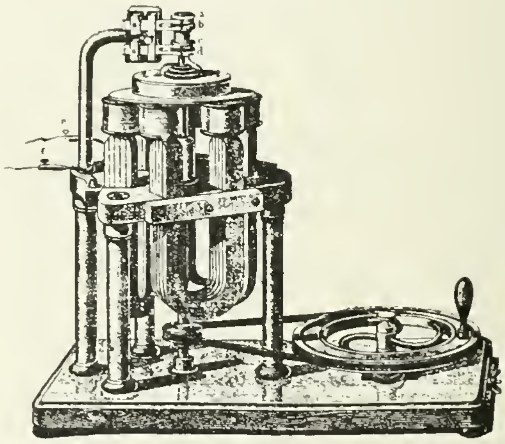


Clarke.

In 1834 and 1836 Pixii's machine was further improved by Saxton and also by Clarke, a magnetic instrument maker of London. In both these machines the armatures were made to revolve, while the magnet remained stationary.

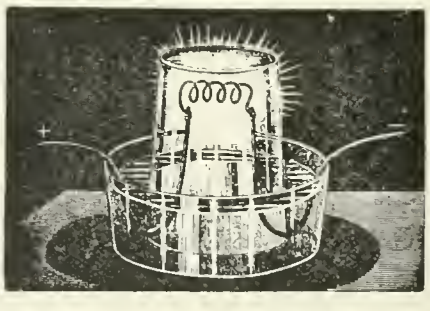
Saxton gave his machine a horizontal position, while Clarke's, as shown by the cut, was arranged vertically. The principle, however, is identical.

The next step in advance was the development of the first multipolar machine constructed in 1844 by Stohrer of Lupzig. It occurred to him that if one magnet and two spools would produce a certain amount of electricity, four magnets and six spools should produce three times as much. His reasoning was vertified.



Stohrer.

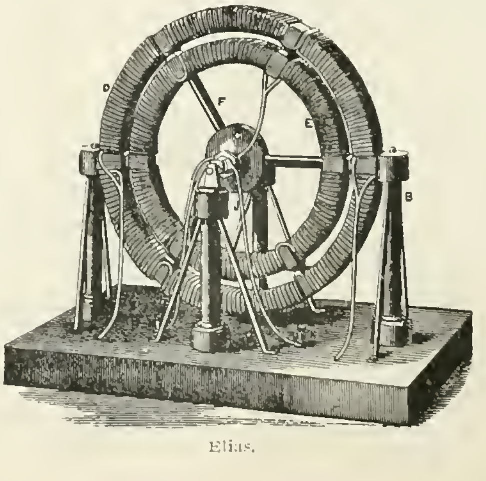
As a matter of general interest I show a cut of the first incandescent lamp constructed in 1840 by Grove. It consisted essentially of a platinum wire attached to suitable terminals.



Grove's Incandescent Lamp of 1840.

This was inserted in an ordinary tumbler inverted in a basin of water. The heat of the wire forced the air out and the platinum then glowed in partial vacuum.

In 1842 Elias, of Amsterdam, constructed an electric motor which consisted of a number of turns of insulated wire wound



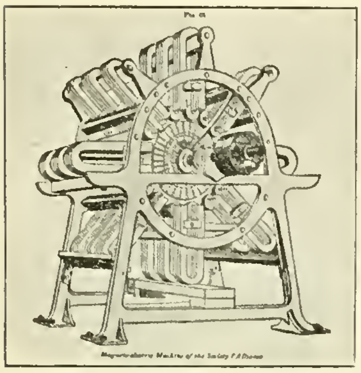
Elias.

around iron rings having slightly projecting poles equally spaced around their circumference. Into each of these coils the current was carried from separate batteries, which resulted in rotation of the inner ring.

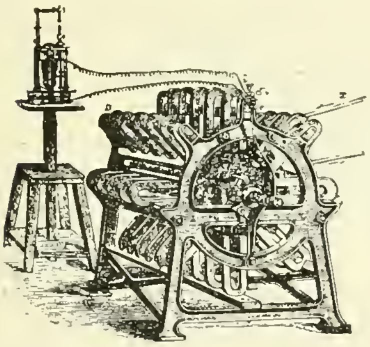
Elias evidently did not carry his investigations far enough to know that the current could be put into the two coils from a single source with the same result ; further, had he connected the coils on both the rings in series and then applied power to rotate the centre ring, he would have discovered the principle of the self exciting electro-magnetic machine, which was presented by Siemens, Wheatstone, Varley and others, twenty-five years later.

I venture to suggest that if Elias had been more persevering in his investigations a long period of inactivity would in all probability never have occurred, and it is difficult to theorize on the possible condition of present development if so many years had not been practically lost.

Little of note was attempted from this period until 1849, when L'Abbe Nollet, Professor of Natural Philosophy at the military school at Brussels, reviewing results obtained by Stohrer with his multipolar machine, perceived that by carrying the multipolar feature further, very powerful currents would be obtained, the ultimate object he had in mind being the decomposition of water, so as to produce gas for use in the oxygen-hydrogen lime light. The idea of using electric current directly from these machines for lighting did not seem to be considered at this time.



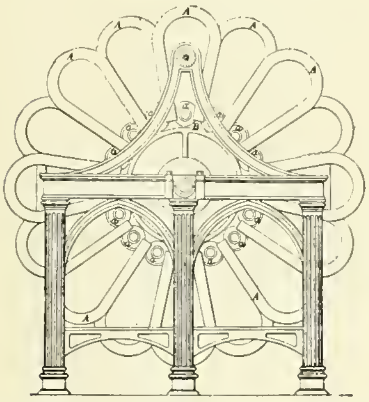
Six of these machines were made in 1853 and taken to Paris for public trial. The illuminating gas bubble proved a ridiculous failure, and the question then arose as to what to do with the machine.



The Alliance Magneto-Electric Machine.

Holmes, who was present at the trial, suggested that they be utilized for the production of electric light, and he adapted the machines to this purpose, and two weeks later he operated from one of these machines an old form of Buboscq lamp.

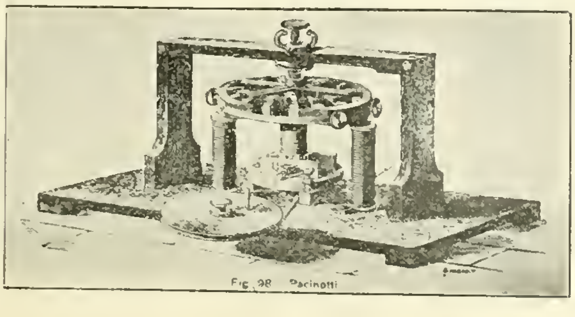
The following year Holmes designed a machine expressly for the production of electric light. This was given a public trial in 1857.



Faraday was present on the occasion and was so pleased with the outcome of his own discovery that he exclaimed to Holmes : "It is my baby, you know, but you have made a man of my infant."

This growth to man's estate had taken over a quarter of a century.

In 1860 Paccinotti, of Florence, brought out an interesting machine having an annular core on which a number of coils connected in series were wound. This was rapidly revolved in a bipolar field. His writings concerning this machine are not clear and it is difficult to interpret his claims, but the machine certainly bears a close resemblance to apparatus invented by Gramme, a number of years later.

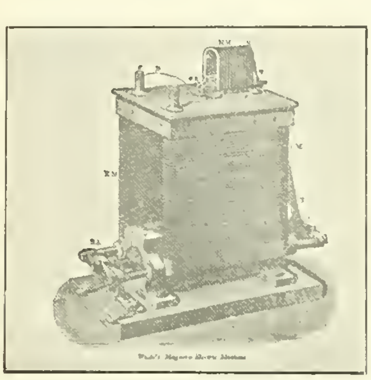


In 1867 Werner Siemens, of Berlin, introduced a self-exciting machine. Siemens, Wheatstone and Varley appeared to have made this discovery simultaneously, in fact, Siemens and Wheatstone each announced the principle before the Royal Society on the same evening.

Siemens.

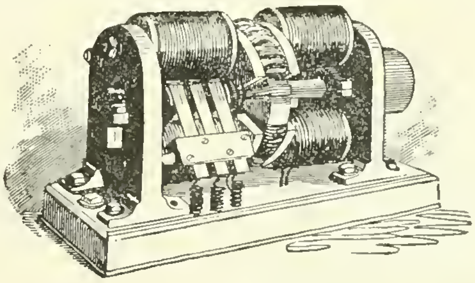
While Siemens is generally recognized as the originator of the ideea, priority is claimed by Moses G. Farmer, of Salem, Massachusetts, who applied for a patent in 1873, which was granted in 1875, and his patent is clearly an anticipation of those described by Siemens & Wheatstone in 1867.

It seems that the secret was suggested to Farmer in 1860, by a friend who described his invention made many years previous, and which he called a cascade or cataract magneto-electrical machine.

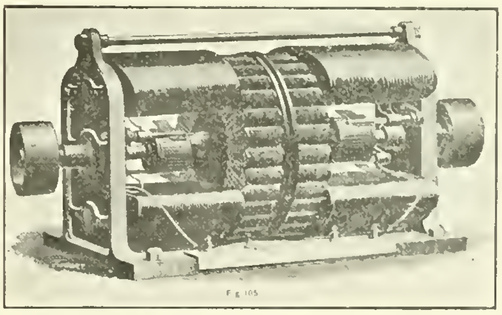


The discovery, to whomever it belongs, at once did away with the objectionable and cumbersome permanent magnet, and a machine for a given output could be made very much more compact and lighter. Such apparatus is called dynamo-electrical machines, indicating that dynamical force is converted into electricity in contra-distinction to the magneto machines, excited by permanent magnets.

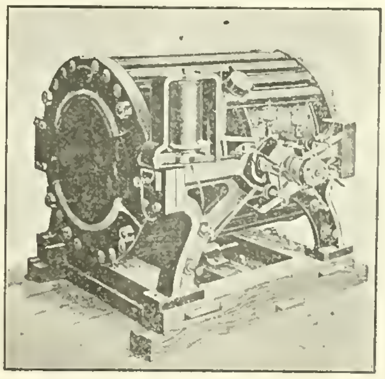
This great discovery was immediately followed by wonderful machine development and a fresh impetus was given to arc lamp construction, and from this period up to the present date work on both machines and lamps has been carried on without intermission.



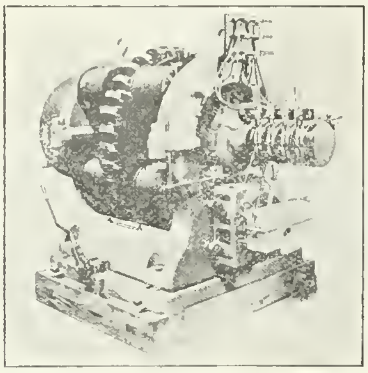
(Early) Brush.



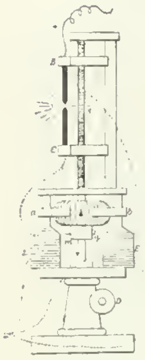
Wallace-Farmer (Duplex).



Thomson-Houston.



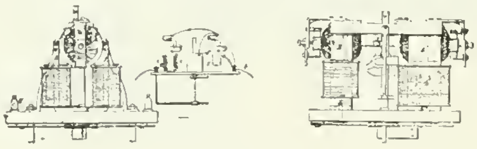
(Modern) Brush.



Tchikoleff.

In 1874 Tchikoleff, Chief of Electric Lighting Service of the Russian Artillery, introduced a differential motor lamp with right and left hand screw. This was followed in 1875 by the Thcikoleff & Kleiber lamp controlled by two motors.

Up to this period no attempt had been made to operate more than one lamp on a machine, so that the idea of having two electric motors in the lamp mechanism was not nearly so absurd as it would appear to-day.



Tchikoleff and Kleiber.

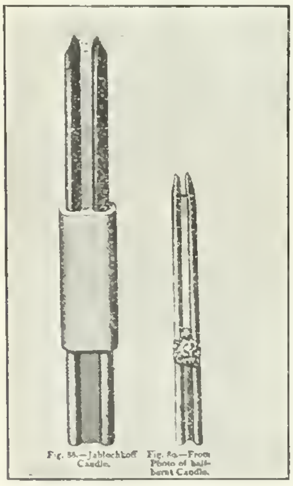
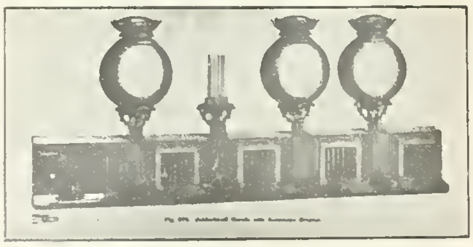


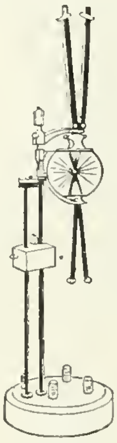
Fig. 58.—Jablochkoff Candle. Fig. 59.—From Photo of half-burnt Candle.

In 1876 Jablochkoff, of the Russian Army, introduced a so-called electric candle which was free from mechanism. This candle consisted of two carbon rods about 3/16″ in diameter and five or more inches long, bound together by suitable material and having interposed between them a non-conducting medium, such as plaster of paris. A small block of carbon cemented to the upper ends of the pencils furnished a means of establishing an arc, which burned about 1½ hours before the carbons were consumed. The candle was open to many objections. It could not re-light if it became extinguished, and the light was unsteady and of a noticeable yellowish tinge.

The next slide shows an arrangement of Jablochkoff candles with automatic bracket brought out in 1878. This it will be noted was an attempt to secure life sufficient to burn one night.

Each receptacle contained six carbon couples. As one set burned out another set was automatically cut in. The apparatus necessary to keep these lamps operating while external to the lamp itself, was of considerable bulk and quite as complicated as the mechanism of some forms of self-contained lamps.





Rapieffe's Lamp.

In 1877 Rapieffe of London patented lamps which could be run six or eight in series. These were installed in the "Times office," London. A suitable cut-out was provided which automatically cut in a resistance when the arc went out.

The lamp has four carbons so that it can be re-trimmed without causing the arc to become extinguished. This might have been useful for lighthouse work, but I can see no other application. The arc was very short and unsteady, in fact, all the earlier arcs were about 30 volts, which is not beyond the hissing point, particularly with the poor non-homogeneous grade of carbons used in the earlier days.

In 1878 Wilde, of Manchester, introduced a candle which was an improvement over the Jablochkoff inasmuch as he did not use insulating material between the carbon pencils, and the candle would automatically re-light if it became extinguished. While the light from this candle was an improvement over the Jablochkoff, still it was open to the same disadvantage of short life and unsteadiness.

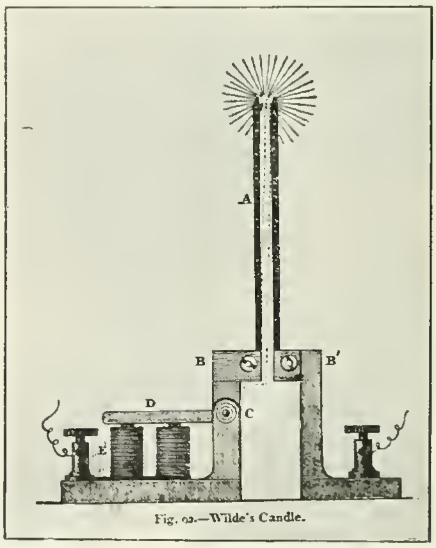
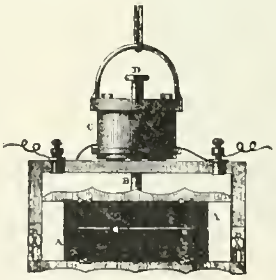


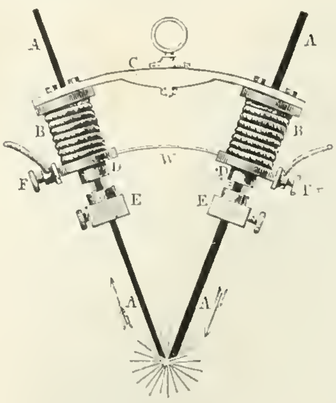
Fig. 92.—Wilde's Candle.

In the same year (1878) Wallace Farmer patented the earliest attempt at a long burning open arc lamp. He used carbon plates in place of pencils and lamps were arranged so that they could be burned six or eight in series, the current being supplied by Wallace-Farmer Duplex Machines. The principal disadvantage of such a lamp is the enormous shadows cast by the lower carbon and the fluctuation and flickering of light as it travels between the plates; furthermore, the surface of the carbon is so great in proportion to the size of the crater that the heat is conducted away by the mass of carbon and the size and temperature of the crater is lowered so that the light giving efficiency is very materially reduced.



The Wallace-Farmer Lamp.

Urquhart brought out in the same year a plate carbon lamp of radically different construction, the carbons being arranged obliquely and the arc playing horizontally between their lower ends. While this arrangement overcame the shadow objection to a considerable extent the light was more or less unsteady and the efficiency low on account of the heat conduction through the great mass of carbon. The lamp was designed to burn 100 hours, but it was necessary to re-adjust the carbons after the lamp had burned about 10 or 12 hours, thus practically destroying the long burning feature.



Urquhart's Lamp. End.

(To be Continued.)

EXHIBITS AT THE TORONTO INDUSTRIAL EXHIBITION.

The display in the Machinery Hall at the Toronto Industrial Exhibition now in progress is about up to the average of recent years. Considering the conditions under which the exhibits were prepared, they are quite as good as could be expected. Many manufacturers report a demand for their goods in excess of the output of their factories, and consequently have been unable to give as much attention to exhibition work as they desired. In some cases goods intended for the Exhibition have been sold and immediate shipment requested.

ELECTRICAL APPARATUS.

There are five exhibitors of electrical apparatus. The United Electric Company, of Toronto, exhibit, as last year, a working plant. A two-phase 75 k. w. induction alternator and a 25 k. w. multipolar generator, driven by a 40 h. p. Bell (Seaforth) engine, are operating motors and series arc and incandescent lamps in use throughout the building and grounds. The arc lights supplied are 66 in number. The Machinery Hall is lighted off the induction alternator, which operates in series 20 series arc lamps on a 2,300 volt alternating current circuit. Seven standard types of motors, a switch-board, arc and incandescent lamps and a line of electrical supplies complete the exhibit.

The Gee Electrical Engineering Companv, Toronto, make their bow in the Machinery Hall this year for the first time. As a young concern they have a most creditable display, consisting of fourteen machines of different types and voltages, the Gould storage battery, and general supplies. Most of the machines shown have been sold, the Dominion government having purchased a 13½ k.w. generator and a 30 h.p. 110 volt motor to swing and light the trolley bridge at Burlington Canal. Mr. W. Gee, the managing director, states that the business of the company is rapidly expanding, and that the capacity of their factory has not been equal to the demand for their goods.

The Toronto & Hamilton Electric Company have an exhibit of dynamos and motors. They report business good, having booked orders for seven machines during the first week of the Exhibition. They have just placed on the market a line of induction motors.

Dynamos and motors comprise the major part of the exhibit of the Consolidated Electric Company, of Toronto. This company claim that their King Edward motor will effect a saving in current of from 30 to 40 per cent. Their head office is at 11 Court street, Toronto, and their works at St. Catharines.

A 60 h.p. Hardill compound engine operates the machines comprising the exhibit of the Jones & Moore Electric Company, of Toronto. They have a 30 k.w. dynamo supplying current to 551 incandescent lights, located chiefly in the Machinery Hall. Their exhibit is tastefully arranged and a pretty effect given by 136 colored lights. A machine is exhibited for extracting tin from iron, used for advantageously working up scrap tin. It is claimed that this is the first machine of the kind to be manufactured in Canada. They also show a full line of motors from ¼ to 15 h.p., electric heaters, medical batteries, telephones, bells, indicators, and specially designed rheostats for automatic cut-off on over-load.

ENGINES AND ENGINEERS' SUPPLIES.

The Goldie & McCulloch Company, of Galt, Ont., exhibit two engines in operation, one a 150 h. p. Wheelock high speed engine, the other a 60 h. p. Ideal high speed engine. These are driving dynamos and other machines in the Hall. The Ideal engine has been sold to the Wiarton Beet Sugar Company for their electric light plant. The Goldie & McCulloch Company also show several wood-working machines.

The Northey Manufacturing Company, Toronto, have their usual interesting display of gas and gasoline engines and pumping machinery, including their triplex power pumps, for which they report a great demand.

The Bradley, Levy & Weston Machinery Company, of Toronto, exhibit one 50 h. p. and one 25 h. p. Hardill engine, driving wood-working and other machinery. They claim that the Hardill engine, for which they are agents, has given excellent results and is worthy the notice of any one interested in power.

" Dominion " gasoline engines and steam specialties, including the Bundy return trap, are exhibited by the Dominion Motor & Machine Company, 50 Esplanade East, Toronto. Their portable engines range in size from 6 to 14 h.p. and their stationary engines from 3 to 28 h.p.

The Fairbanks Company, of Montreal, exhibit gas and gasoline engines, also in a separate space a full range of their celebrated valves.

The Hamilton Manufacturing Company, 98 Church street, Toronto, have a display of metallic high grade engine and pump packings, " Neverslip " pulley covering, oil filters and general engineers' supplies. They claim to be the only manufacturers of metallic packing in Canada.

The Eureka Mineral Wool and Asbestos Company, Bay street, Toronto, have a splendid exhibit of pipe and boiler covering, engine packings, etc., with a pyramid of their goods in the centre of the space. They show mineral wool before and after being manufactured, which has attracted much attention.

Mr. E. L. Purves is in charge of the Mica Boiler Covering Company, represented in Western Ontario by the Luxfer Prism Company, Toronto. A circular wooden model about eight feet in diameter is covered by the prepared mica, all corrugated but without the canvas covering, while there is an equally good display of the goods ready to be applied to the pipe. Mica covering is manufactured in two classes, one for boiler and cylinder covering and the other for steam and hot and cold water pipes.

The Crown Boiler Compound Company, Toronto, show several barrels of boiler compound.

The Grant Hamilton Oil Company, of Toronto, in conjunction with A. W. Spooner, have a good display of Spooner's copperine, " P.S.A." steam boiler straightway balanced blow-off, Sterling paints in all colors, and a range of specialties.

The James Morrison Company, Toronto, have in their exhibit the J. M. T. injector, throttle valves, swing check valves, Hancock inspirators, etc.

OTHER EXHIBITS.

A full line of shafting and power transmission machinery in operation is exhibited by the Dodge Manufacturing Company, of Toronto. The exhibit includes wood split pulleys, friction clutch pulleys and couplings, Dodge system of rope driving, etc.

The only belting concern represented in the Machinery Hall is D. K. McLaren, of Montreal and Toronto. Mr. C. Bradfield is in charge. The exhibit comprises English oak-tanned belting, card clothing and cotton mill supplies, Lancashire, balata and cotton belting, and belt hooks and appliances in all sizes.

There are three exhibitors of babbitt metal. J. N. Tallman & Sons, of Hamilton, show in addition to babbitt metal, bronze, brass and aluminum castings. The Canada Metal Company, Toronto, have on view ten tons of metal, including lead and block tin pipe, electric battery zincs, babbitt metal, etc. J.T. Wing, of Detroit, confine their display exclusively to their high-speed graphite babbitt metal, of which they make a specialty. Their travelling representative in Canada is Mr. J. F. Birchard.

Roller bearings are exhibited by the Toronto Roller Bearing Company and the Chapman Double Ball Bearing Company. The latter have in operation a cylinder weighing 6,728 pounds, which spins on a Chapman bearing 56 minutes after the power is thrown off, as compared, they claim, with 2½ minutes on a journal bearing.

ENGINEERING and MECHANICS

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

THIRTEENTH ANNUAL CONVENTION.

At the thirteenth annual convention of the Canadian Association of Stationary Engineers, which opened in Engineers' Hall, 61 Victoria Street, Toronto, on August 19th, the following delegates answered the roll call: C. Moseley, Toronto president; W. Oelschlager, Baden, vice-president; A. M. Wickens, Toronto, secretary; G. W. Dawson, Hamilton, treasurer; J. Struthers, Sarnia, door-keeper; N. V. Kuhlman, A. Storer, R. H. Johnston, W. J. Webb, of Toronto No. 1; R. C. Pettigrew and J. Ironsides, of Hamilton No. 2; Walter Inglis, Toronto No. 18; Joseph Ogle, Brantford No. 4; William Jamieson, Dresden No. 8; J. Walker, Berlin No. 9; W. F. Chapman, Brockville No. 15; N. Beam, Waterloo No. 17; G. M. Taylor, Vancouver No. 19; W. D. Hall, Sarnia No. 20; F. Donaldson, Ottawa No. 7.

W. OELSCHLAGER, Baden, Ont.,
President Canadian Association of Stationary Engineers.

The delegates were welcomed by R. H. Johnston, president of Toronto No. 1, and J. Huggett, chairman of the Reception Committee, after which the president delivered the following address:

"I have the pleasure to welcome you to this, our thirteenth annual convention. I am sure that in selecting you as delegates to this convention your lodges have selected the best men. I feel sure that great good will be done, and that you will give your best consideration to the various questions that may come up. One question that will be brought before you, is that of affiliating with the International Association of Steam Engineers. I hope that whatever is done in this matter will be for the advancement of the organization. There is another question of much more importance, and that is of getting a license law, or legislation that will better the condition of the engineers and the safety of the public at large. This ought to be discussed thoroughly, with the object of deciding upon some definite plan of procedure at the coming session. During the last year there have been two boiler explosions in Ontario, with three persons killed and thousands of dollars' worth of property destroyed.

"I am pleased to say that since the last convention one new association has been formed, in Rossland, B.C., with a good membership, and I hope that during the coming year more advancement will be made in this regard. This could be done by appointing some brother as organizer. Our membership has slightly increased during the year, and all the lodges are in a prosperous condition. I had hoped that some of the delinquent associations would have been brought into active work again. I think that had I the time to pay a visit to these places I might have had a better report to make. I hope the incoming officers will pay special attention to this. I might say that we have been in communication with several of these lodges. The educational work of the order has been well looked after in all the subordinate lodges. This is, of course, a great benefit to the members. I hope that during the coming year more advancement will be made in this good work. During the year I had the pleasure of visiting Hamilton No. 2, when two-thirds of the members were present, and the business of the lodge was conducted in a satisfactory manner. On the 13th of June I visited Toronto No. 18. In this lodge I found very few members turn out on meeting night, and the work of the lodge was not done very well, owing to the officers of the lodge not being present. Bro. Wickens visited Dresden No. 8, on February 1st. This lodge met in the town council chambers with all the members present. They are fully alive, and they take up all points that are for their own advancement. Also on February 3rd he visited Sarnia No. 20, and found them very comfortably situated in a pleasant room. Nearly all the members were present, and the business was carefully and well conducted. The brothers asked many questions relating to the C.A.S.E."

Standing Committees having been appointed, Secretary Wickens presented his report. He was not able to report an increase in membership, the list now standing at 275. A new association had been formed in Rossland, but he had not been able to get a report, and there was an indebtedness to the Executive for per capita dues. Vancouver No. 19 and Hamilton No. 2 increased their membership during the year. The Educational Committee had issued only two papers, while no report had been received from the Legislative Committee, but the Secretary understood that it was decided to allow the question of a license law to stand over until another session. The secretary stated that he received answers from several associations on the subject of affiliating with labor bodies. He also recommended that at least six instruction papers be issued during the coming year, and that the initiation fees, dues and per capita tax be raised in order to provide more money for advancing the interests of the association.

A report from the Executive Committee on the question of affiliating or amalgamating with other organizations was read. The Standing Committees then reported. The Auditing Committee found a balance on hand of $202.70.

The Good of the Order Committee submitted the following recommendations: 1. That none but a president or past president of a subordinate lodge be eligible for election to the chair of president or vice-president of the executive. 2. That we have the union label put on all our printed matter in future. 3. That the preamble to our constitution be discarded. 4. That the leaflets be continued, and that some one be appointed at a salary to get up the same. 5. That the per capita dues be raised from 50 cents to 60 cents per annum per member. 6. That there be three district deputies appointed, and that said deputies act as organizers in their districts, and visit each lodge at least twice during the year, reporting the proceedings to the executive secretary immediately after each visit. 7. That a strong committee be appointed as a legislation committee for the purpose of adopting means of securing a license law from the Ontario Government, said committee to act in conjunction with the Ontario Association, and all other subordinate associations; also that the

W. INGLIS, Toronto.
Secretary Canadian Association of Stationary Engineers.

executive treasurer honor their bills to the amount of $75. These recommendations were adopted.

The outcome of the report of the Ways and Means Committee was that the president and secretary were appointed to deal with the Rossland association regarding non-payment of dues, and as to affiliation with the International Union of Steam Engineers, it was decided to retain the identity of the C.A.S.E. for another year at least. Subordinate associations are to be allowed to use their own discretion as to the advisability of affiliating with the Trades and Labor Council.

At the afternoon session Mr. G. V. Lighthall, president of the International Union of Steam Engineers, addressed the convention. He is, naturally, a strong advocate of unionism, and argued that the C.A.S.E. would be taking the proper steps by affiliating with the International Union. He contended that stationary engineers, instead of bettering their positions, were going down grade. He contended for a minimum wage for the engineer of $3 per day of eight hours, while the present scale was $1.85 for 12 hours. That was the goal the International Union was striving for. He advocated arbitration and discouraged strikes.

A. E. Edkins said that while he had not been altogether in sympathy with labor organizations, be believed that the time had come when the engineers should attach themselves to some union body, as by this means they would be given a standing and it would assist them to obtain legislation.

After further discussion it was announced that a moonlight excursion around the city and luncheon at Sunnyside had been arranged for. Messrs. Edkins and Webb, who were leaving the following morning for England, were tendered unanimously the best wishes of the Association.

About one hundred and fifty persons enjoyed the moonlight excursion and luncheon gratuitously provided by the local Association. At Meyer's Cafe, on the Lake Shore road, tables were spread for the party, and after satisfying the inner man, attention turned to the toast list. The speeches were brief, leaving ample time for the excellent programme of songs that had been arranged for. After honoring The King, the toasts and respondents were : "Our Guests," by C. H. Thompson, of the Otis Elevator Company, and G. V. Lighthall ; "Visiting Engineers," W. Oelschlager and J. Ironsides ; "The Executive," C. Moseley and A. M. Wickens ; "Reception Committee," J. Huggett and G. C. Mooring ; "The Press," A. W. Smith, Canadian Engineer, T. S. Young, ELECTRICAL NEWS, and J. Laing, Toronto World. Songs were contributed by Messrs. Donald C. McGregor, LeRoy Kenney, Bert Harvey, George T. Beales, Robert Wilson and Robert Brown. H. S. Fletcher presided at the piano.

General business and election of officers comprised the business of the second day. The question of furnishing instruction papers received much attention, and finally it was left in the hands of the Educational Committee. Opinion was divided as to whether it was advisable to mail the papers to each member direct or send them to the local secretaries for distribution.

The election of officers being reached, A. M. Wickens, secretary, announced that he had decided to retire from office. Mr. Wickens has held the office for many years and given much time and attention to the interests of the Association. The following officers were elected : President, W. Oelschlager, Baden ; Vice-President, H. E. Terry, Toronto ; Treasurer, James Ironsides, Hamilton ; Secretary, Walter Inglis, Toronto ; Conductor, James Struthers, Sarnia ; Doorkeeper, N. Bean, Waterloo.

At the evening session a past-president's jewel was presented to the retiring president, C. Moseley. Officers were installed and the following committees appointed by President Oelschlager.

Educational—A. M. Wickens, G. C. Mooring, H. E. Terry, N. V. Kuhlman and J. Fox.

Legislation—C. Moseley, W. Inglis, A. Storer, W. J. Webb, R. Pettigrew, W. F. Chapman and J. Huggett.

District Deputies, offices which had been abandoned for some time, were appointed as follows—Eastern Section, F. Donaldson, Ottawa ; Western, O. P. St. John, Toronto ; Central, A. E. Edkins, Toronto.

It was decided to hold the next annual convention in Berlin. A grant of $30 was made to the Educational Committee, another of $25 to the secretary, and a small sum of money to the caretaker of Engineers' Hall. The usual votes of thanks were passed, including one to the parties who had extended invitations to visit their plants.

NOTES.

The local committee consisted of Jas. Huggett, chairman, G. C. Mooring, W. J. Webb, J. G. Bain, A. M. Wickens, Jas. Bannon, N. V. Kuhlman, W. H. Johnston, S. Thompson, W. L. Outhwaite, Treasurer, R. H. Johnson, Secretary.

The convention programme was a creditable production, and was accorded a liberal advertising patronage.

The Underfeed Stoker Company gave a handsome pocket-book to the delegates, and the Eureka Mineral Wool Company a neat pen and holder.

Mr. W. Oelschlager, president of the C.A.S.E., is a member of the firm of Oelschlager Bros, of Baden, Ont., engineers and machinists and manufacturers of Corliss engines, wood-working machinery, elevators, etc. Within a short time this firm have built up a splendid business. They have now on order six Corliss engines, two elevators, and six carloads of wood-working machinery. They make Corliss engines from 30 to 100 h. p. Mr. Oelschlager has always taken a deep interest in the success of the C.A.S.E., and the honor now bestowed upon him is well deserved.

Mr. Walter Inglis, the new secretary, joined Toronto No. 18 in 1892. He was financial secretary for two years, and afterwards president of that branch. He comes to his present honor the first year he has attended the convention as a delegate.

METRIC WEIGHTS AND MEASURES.

We reprint from the August number of the American Consular Reports the following list of metric weights and measures :

METRIC WEIGHTS.

Milligram (1-1,000 gram) equals 0.0154 grain.
Centigram (1-100 gram) equal 0.1543 grain.
Decigram (1-10 gram) equals 1.5432 grains.
Gram equals 15,432 grains.
Decagram (10 grams) equals 0.3527 ounce.
Hectogram (100 grams) equals 3.5274 ounces.
Kilogram (1000 grams) equals 2.2046 pounds.
Myriagram (10,000 grams) equals 22.046 pounds.
Quintal (100,000 grams) equals 220.46 pounds.
Millir or tonnea—ton (1,000,000 grams) equals 2,204.6 pounds.

METRIC DRY MEASURES.

Milliliter (1-1,000 liter) equals 0.061 cubic inch.
Centiliter (1-100 liter) equals 0.6102 cubic inch.
Deciliter (1-10 liter) equals 6.1022 cubic inches.
Liter equals 0.908 quart.
Decaliter (10 liters) equals 9.08 quarts.
Hectoliter (100 liters) equals 2.838 bushels.
Kiloliter (1,000 liters) equals 1,308 cubic yards.

METRIC LIQUID MEASURES.

Milliliter (1-1,000 liter) equals 0.038 fluid ounce.
Centiliter (1-100 liter) equals 0.338 fluid ounce.
Deciliter (1-10 liter) equals 0.845 gill.
Liter equals 1,0567 quarts.
Decaliter (10 liters) equals 2.6418 gallons.
Hectoliter (100 liters) equals 26.417 gallons.
Kiloliter (1,000 liters) equals 264.18 gallons.

METRIC MEASURES OF LENGTH.

Millimeter (1-1,000 meter) equals 0.0394 inch.
Centimeter (1-100 meter) equals 0.3937 inch.
Decimeter (1-10 meter) equals 3.937 inches.
Meter equals 39.37 inches.
Decameter (10 meters) equals 393.7 inches.
Hectometer (100 meters) equals 328 feet 1 inch.
Kilometer (1000 meters) equals 0.62137 mile (3,280 ft. 10 in.)
Myriameter 10,000 meters) equals 6.2137 miles.

METRIC SURFACE MEASURES.

Centare (1 square meter) equals 1,550 square inches.
Are (100 square meters) equals 119.6 square yards.
Hectare (10,000 square meters) equals 2.471 acre.

Increased business has compelled the Lindsay Light, Heat & Power Company to duplicate their plant at Lindsay, Ont. Orders have been placed for a new water-wheel, 400 k.w. generator, with switch-boards, transformers, etc., and about 40 miles of No. 4 copper wire. The new plant will mean an addition of about 600 horse-power.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, SEPT. 3RD, 1902.

The frequent query "what will I do with my boy" is apt to be asked more often if the public use boys in other trades in the same manner as they do those working their way up practically in electric construction. The call is "why don't you send a man," when possibly for a trifle that were a man sent the next kick would be, "a boy would have done as well." However, if the public only knew that the class of boys employed in the electrical field have got to be smarter somewhat than those in many other trades, they might not be so quick in objecting; at any rate, so long as the firm "stand behind" their work, be their employees with beards or without, the public have no real ground for complaint. The business in itself is so young that it would be a hard matter to pick out many with grey hairs actively engaged therein.

The C.E.A. "standing" committee to wait on the underwriters may as well, to use a slang phrase, "go away back and sit down." They are on the wrong tack so far as Montreal is concerned, and will accomplish nothing that way. So says a contractor who has pretty fair knowledge of the difficulties to be encountered along that line.

The alternating arc lamps are nearly all hung and it is a question if the average citizen who has occasion to use the streets at night has ever noticed the difference from the old direct current ones.

Mr. Geo. H. Hill, lately with the Bell Telephone Company, and pretty well known among the boys, is about to start in business in the manufacture of switches, switch-boards, and similar apparatus. Some well known Montrealers are with Mr. Hill and financially backing the company, which we understand will be incorporated.

The Electrical Contractors' Association take up the question of compulsory inspection at their next meeting. It is understood that the proposition will be on novel lines which, if carried, will go a long way toward solving the question of interior wiring without troubling either Underwriters or City Hall.

Fan motor trade in Montreal this summer has been a flat failure so far, owing to the continuance of cool and rainy weather. Trade in general has been rather quiet during July and part of August, but is picking up and bids fair to be lively in September.

Some are inclined to doubt the soundness of the Shawinigan Company's desire to illuminate the St. Lawrence channel from Quebec to Montreal. But why not? The same scheme to a certain extent is working at the very United States port that Montreal is competing with. The scheme put into operation would be of incalculable benefit to the whole eastern part of the Dominion.

One of the most aggravating happenings, and one which happens very often, is the practice of the United States houses to express a rush order and not rush the invoices. It may be hustling to get the order shipped promptly, but such hustle does us no good when there is no bill to clear the goods from "bond." Our U. S. friends must remember that in spite of their good wishes, this is still a foreign country, and probably likely to remain so for some time unless they change their flag and annex.

Another so-called electric fire at the Mount Royal Club has been satisfactorily accounted for before the Fire Commissioners as being a defective chimney flue. Next? This old joke has been so worked to death now that even the public at large are beginning to appreciate the fun of it. True, with the interior wiring as it used to be, fires were likely to occur, but whether luck or no the fact remains that few, if any, fires have occurred by normal interior voltage. When 2,000 volts potential strikes interior wiring, however, it is a different question, and no matter how carefully the wiring of the building may have been done, something is sure to happen. "Visible defects" in the interior wiring have been pretty well cleaned up in Montreal during the past three years, and things are in fairly good shape. Toronto and Ottawa please copy.

CARE OF INNER GLOBES.

ENCLOSING GLOBE BREAKAGE.— In the more modern systems of arc lighting where the enclosed globe type of arc lamps is being used exclusively, the subject of enclosing globe renewals is an important item of central station maintenance. Upon the condition of the enclosing globe and the joints at the holder and cap depend to a large extent the uniformity and length of the carbon life, which are some of the most important advantages claimed for enclosed arc systems. In order to secure these advantages, however, it is evident that there must not be too free an entrance of air to the enclosing globe, and that renewals of enclosing globes must be made regularly, thus avoiding the continued use of defective globes.

CAUSES OF GLOBE BREAKAGE.— A large percentage of necessary globe breakage can be traced to careless handling. No station manager or superintendent would countenance any evident carelessness of employees resulting in the cracking or breaking of a large number of globes. At the same time, however, a great amount of carelessness does exist, as will be shown by the number of globes having nicks at the top or bottom. These nicks, which are very easily overlooked, shorten the life of the carbon and form an excellent start for a crack when the globe is subjected to heat variation. No globes should be used which do not have perfectly ground edges. In transportation and the operations of cleaning and placing the globe in its holder and underneath its cap, as great an amount of ordinary care should be exercised as in the handling of other equally fragile glassware. Each lamp trimmer should know that no lamp on his circuit has a cracked or nicked globe.

IMPROPER ADJUSTMENT OF LAMPS FOR EXISTING CURRENT CONDITIONS.— The cause of excessive globe destruction due to improper lamp adjustment can be readily seen by an examination of the globes, where effects of large arc watt consumption and excessive heat will be evident. The globes will be found to be sagged on one or all sides, due to softening of the glass, or the glass may be blackened at the top. A globe subjected to this intense heat will not maintain a true surface contract and should not again be used. No attempt should be made to use a lamp on a circuit for which it is not intended. Care should be taken to see that it is properly adjusted for the circuit on which it is to run, and neither the lamp nor its adjustments should be condemned, unless, without question, the circuit conditions are what they are nominally supposed to be. This applies to the current on series circuit, the potential at the lamp terminals on multiple circuits, and the frequency on alternating circuits.

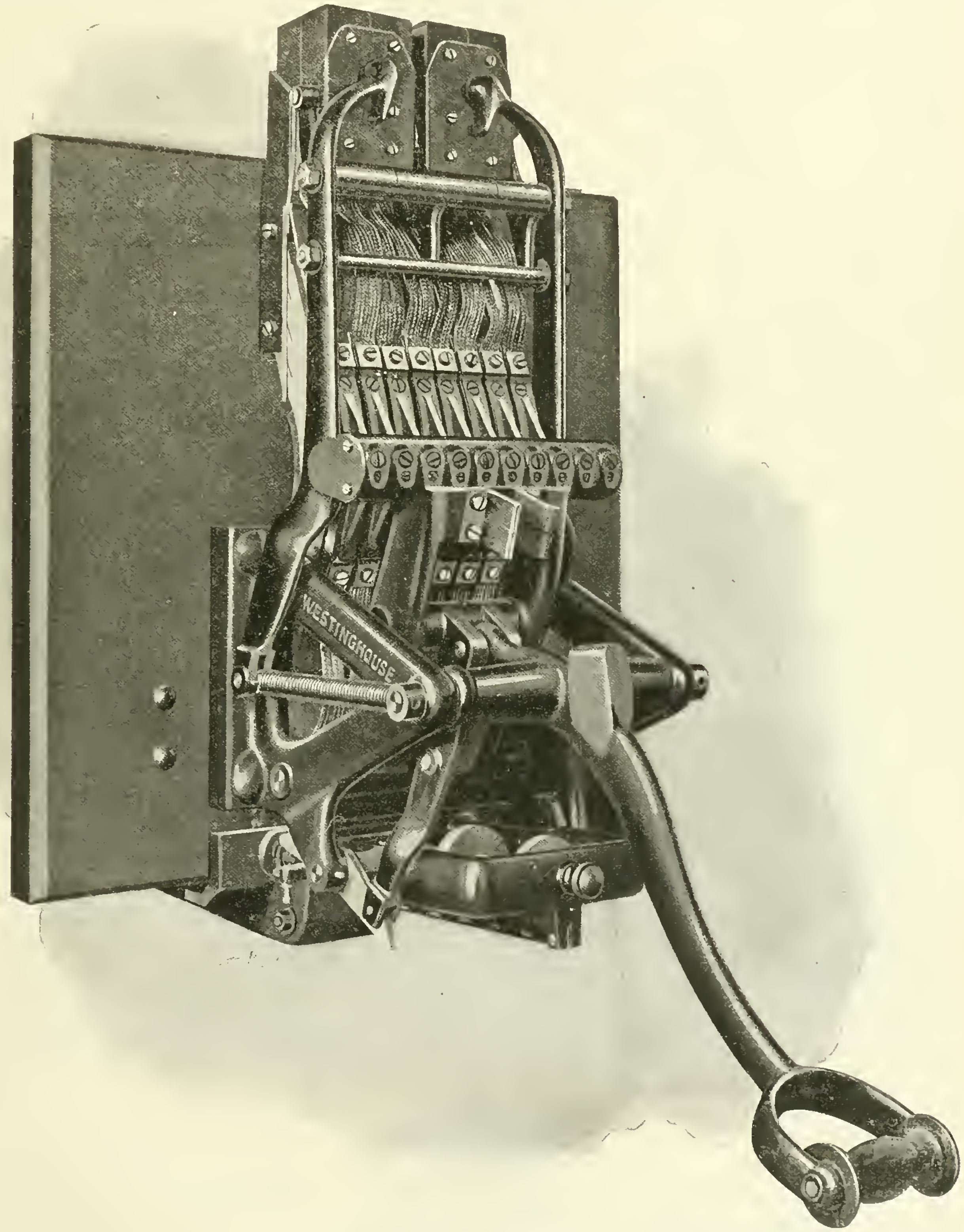
CARELESS TRIMMING.—Results very similar to those caused by high arc voltage may be obtained by the insertion of incorrect lengths of lower carbons, the "too long carbon" causing cracking or melting of the globe near the top, and probably burning the cap and forming a dark reddish deposit on the globe surface; the "too short carbon" causing the melting of the globe at the bottom, and partial or total destruction of the lower carbon holder. Never put in a lower carbon longer or shorter than 5¾.

CLEANING OF ENCLOSING GLOBES.—If an enclosing globe be merely wiped or brushed out at occasional trimmings it soon becomes discolored, due to the deposit being burned into the glass, and an appreciable percentage of light is cut off. The globe must then be either destroyed or cleaned with acid. Repeated use of acid shortens the life of the globe.

METHOD OF TRIMMING.—The very successful method of cleaning enclosing globes, and trimming the lower holders at the station as facilitated by the removable type of enclosing globe holder, is strongly recommended. Having the globes brought into the station at each trimming will give the superintendent an opportunity for securing information regarding the system which otherwise would be very difficult for him to obtain. Here he has the globe and pair of carbons showing the condition of the lamp from which they have been taken. By examining the conditions of these carbons and comparing the length of them a very good idea is obtained both of the individual arc adjustment and the uniformity of arc adjustment of all lamps of the system. Flat and mushroomed ends, together with exceptionally long residue carbons, indicate low arc voltage and short arc; pointed carbons and short residue indicate flaming arc and immediately suggest an abnormal arc voltage or possibly undue entrance of air to the enclosing globe. An examination of the globe may disclose a crack, a nick at the top or bottom, a globe tilting or loose in the holder, or no asbestos washer. Individual cases of short arc and long life might occur from an exceptionally hard pair of carbons or from the core having dropped out of the upper carbon. Again, a pair of very soft carbons might be responsible for the long arc and short life, but generally speaking a comparison of results during a certain period gives an opportunity for an efficient organization which is sure to produce commercially satisfactory and even gratifying results.—From leaflet issued by Canadian General Electric Company.

LARGE CAPACITY CIRCUIT BREAKER.

The use of very large direct-current generators for railway service and the necessity for securing uninterrupted operation has confronted electrical manufacturers with a difficult and serious problem in the design of circuit breaking devices, as the requirement of such large units exceed all previous undertakings in the amount of power delivered to the system. To handle circuits of this nature transmitting such large amounts of power requires that a general design, both mechanical and electrical, of the circuit breaking devices must be of the highest order to insure the greatest degree of safety and reliability of of operation.



Large Capacity Circuit Breaker.

For the direct-current generators recently constructed by the Westinghouse Electric & Manufacturing Company for the Boston Railway Company, it was necessary to build switchboard apparatus of unusual size, the most notable of which is an automatic circuit breaker. In the accompanying illustration is shown the type of circuit breaker supplied with the above mentioned generators. The normal rating of the breaker being 8000 amperes capacity, places it among the largest circuit breakers yet manufactured. This piece of apparatus is an enlargement of the standard Westinghouse Type "C" circuit breaker.

The Westinghouse Type "C" circuit breaker is of the laminated brush type and is made in 1, 2, 3 and 4 pole combinations, each element of the set being provided with an automatic tripping coil which acts independently of the others or they may be made to operate simultaneously if desired. In general this breaker consists of an upper and lower contact block connected together by laminated copper brushes. Upon these brushes phosphor bronze springs are placed and upon these are the carbon contacts or arcing points; the brushes are held in contact with the cantact blocks by means of a toggle mechanism locked by a trigger attached to the scale beam. (The 8000 ampere breaker has an adjustable range between the limits of 2,000 and 10,000 amperes). To avoid any possibility of arcing at the laminated copper brnshes, woven copper cables are fastened from these brushes to the carbon arcing points.

In operation, the action of the circuit breaker is as follows: The passage of the circuit through the lower stud brushes and upper stud energizes the "U" shaped magnet which attracts the armature. This releases the trigger, unlocking the toggle joint, and copper spring brushes throw the breaker open. In breaking contact, the copper brushes leave the contact block first, aided by the pressure of the brushes which act with the releasing spring instead of against it, followed by the phosphor bronze spring, then the carbon block or arcing point of the out-moving breaker armature separates from its carbon contacts and its circuit is broken. By this method the current is gradually shunted from the carrying brushes to the carbons, thus preventing any arcing from the metal parts of the breaker.

THE BERLIN-BRIDGEPORT ELECTRIC RAILWAY.

The town of Berlin and the village of Bridgeport, Ont., are now connected by an electric railway, thanks to the enterprise of Mr. W. H. Breithaupt. On the opening day early in August an invitation was extended to the Berlin and Waterloo township councils and a number of other persons, a special car conveying the party to Bridgeport, where they were banqueted by the management of the road. In responding to the various toasts, Mr. Breithaupt, the president of the Berlin and Waterloo Street Railway Company and the Berlin and Bridgeport Electric Railway Company, was highly commended for his foresight and enterprise in extending the road to Bridgeport. Ultimately the road is likely to form a belt line to Waterloo.

The line from Berlin to Bridgeport is two and one-quarter miles long, of which about one and one-half miles are on private right of way and the balance on Berlin streets, for which the company has a twenty year franchise. The Grand Trunk Railway is crossed by an overhead bridge, the steepest grade on the approaches to which is about three per cent. Otherwise most of the grades are one and one-half and two per cent.

The equipment consists of one two-compartment 40 feet suburban car, with cross seats in one compartment, having Canada Switch & Spring Company's trucks and four Westinghouse 12 A motors. The car body was built by A. C. Lariviere, of Montreal. The road is operated by the Berlin & Waterloo Street Railway Company, which has in all, including the Bridgeport car, 14 cars and trailers, seven of them being complete mortor equipments. The company recently installed an 80 ampere Gould storage battery, which provides for power also for the new line.

LAMP HINTS.

The frosting of lamps much improves their diffusion of light, and their use should be much increased in view of the agreeable and effective light resulting. Contrary to the common impression, the loss of light through frosting is very small, the average total loss being only about three per cent.

For decorative illumination, low candle power lamps should be used, lamps of eight or ten candle power giving much more effective and artistic results than those of higher candle power.

Do not expect a lamp ordered for one voltage to give satisfaction on another voltage. If the voltage at different points on your system is widely varying, use lamps of different voltages to suit.

The approximate variation in candle power and life corresponding to various percentages of the normal voltage is shown by the following table :

Voltage per cent of normal	Candle Power per cent. of normal	Life per cent. of normal
90 per cent.	53 per cent.	850 per cent.
95 "	73 "	300 "
97 5 "	86 "	175 "
100 "	100 "	100 "
102.5 "	115 "	60 "
105 "	132 "	35 "
110 "	172 "	14 "

The average life of 3½ watt lamps is one-half that of lamps having an efficiency of 4 watts per candle. The 3 watt lamp has about half the life of the 3½ watt.

For equal results in useful life low candle power lamps must have lower efficiencies than lamps of sixteen candle power.

Do not expect to measure the efficiency of a lamp accurately with a recording watt meter.—From Packard Electric Company's Lamp Catalogue.

SPARKS.

Mr. H. A. Connell, of Woodstock, N.B., has placed a turbine wheel of 150 h.p. in the Davis mill property, and another of 250 h.p. is to be installed. Mr. Connell will supply power to his foundry and run his electric lighting system. Mr. Connell, by the use of the water power of the Meduxnakeag, expects to effect a saving in fuel of over $3,000 per year.

Suit has been entered against the town of Orillia, Ont., by P. H. Patriache and the Electrical Maintenance & Construction Company, of Toronto, to recover the sum of $220,000 as damages claimed for the breaking of a contract for the building of a power plant, the company claiming that the town officials were negligent, and so contributed to the delays which finally caused the rupture. The defence enters a general denial to this charge, and says that the contractors brought the trouble upon themselves.

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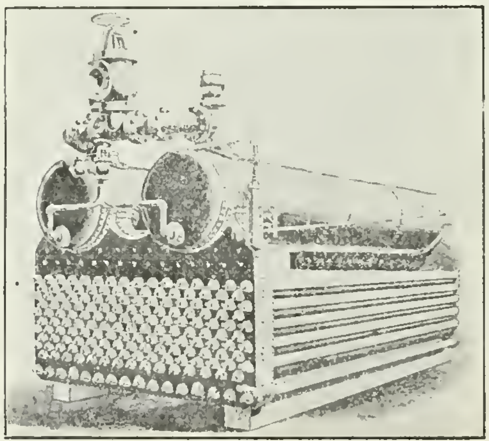

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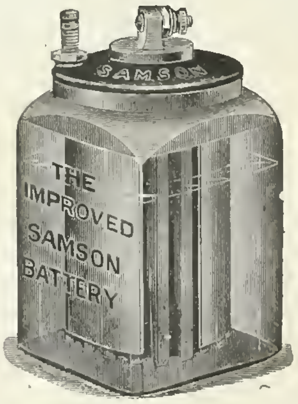

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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XII. OCTOBER, 1902 No 10.

IMPROVEMENTS AT FREDERICTON, N. B.

Fredericton, the capital city of New Brunswick, is one of the most attractive towns in Canada. It has many handsome buildings and the streets are lined with magnificent trees. In front flows the broad river spanned by two bridges nearly a mile in length. A great deal of public spirit is manifested in many directions. Among the more recent improvements is the substitution by the electric light company of modern enclosed arc lamps for the old-style open arcs on the streets and in the stores and other business places. The improvement is a very noticeable one and has given the greatest satisfaction to the citizens, besides relieving the company of complaints of lights out, which with the open arcs were quite frequent and entailed not only inconvenience to customers, but loss to the company, who by the terms of their agreement were charged double price for all lamps which failed to operate continuously. The company are understood to be considering further improvements which will enable them to give an all night service. At present the plant is operated on the moonlight schedule.

Sixty-seven arc lights are supplied under contract with the city to light the streets, and 35 for commercial lighting. In addition there are about 350 incandescent lights. Current for the arc lighting is generated by a Reliance and a new Brush dynamo, and for incandescent lighting by two Edison D. C. machines. The Brush machine is operated by a 50 h. p. Armington & Sims high speed engine, and the other machines by a 50 h. p. Wheelock made by the Goldie & McCulloch Co., of Galt, Ont. A 100 h. p. Armington & Sims engine is kept in reserve and will no doubt shortly come into use when the service is extended. A new brick chimney stack is in process of construction, which gives improved draft.

PARLIAMENT BUILDINGS, FREDERICTON, N. B.

The company control the supply of both electric light and gas, and represent an amalgamation of two companies which previous to 1900 operated individually. The electric light plant is in charge of Mr. W. H. McGinn, who has had the management ever since the plant was first installed, thirteen years ago, with the exception of a few months. The appearance of the station is a sufficient proof of his intelligent care. There seems little doubt that in a city of 7,000 inhabitants, the field for incandescent lighting can be greatly extended, and that, too, without greatly interfering with the gas lighting. There is also no doubt a field for the supply of electric power, which as yet has received no attention whatever.

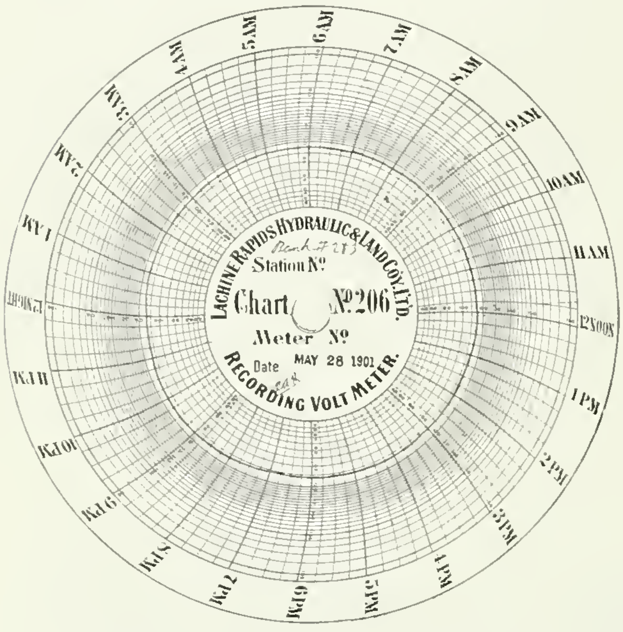
STEAM VS. WATER POWER.

SALT LAKE CITY, UTAH, Sept. 11th, 1902.

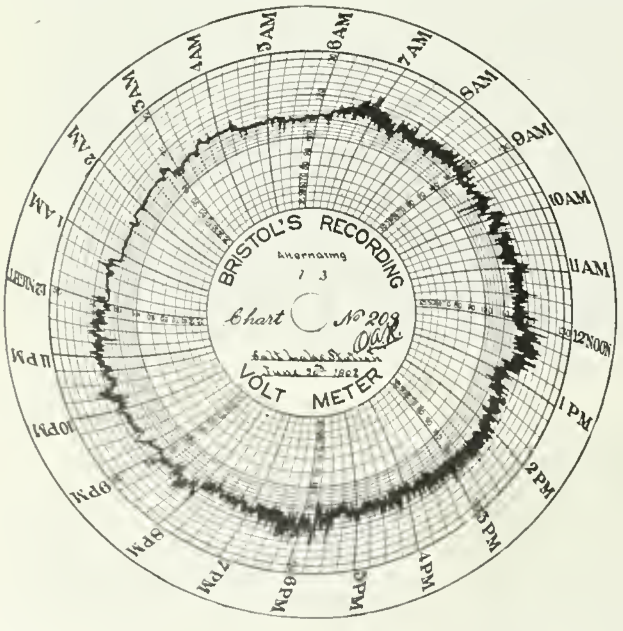
Editor CANADIAN ELECTRICAL NEWS :

DEAR SIR:—Referring to your editorial, "Steam vs. Water Power," in the August issue, I send you a blue print of a voltage chart taken off the main distribution busbars of a Canadian plant, with which, perhaps, you are very familiar.

From this station we supplied both our motor and lighting load, and the regulation shown by this chart was maintained month after month, showing that on a low head plant (17 feet) with a proper governor installation it is possible to obtain a thoroughly satisfactory regulation. This was without any steam or storage battery auxiliary. The maximum load reached 6,000 h.p., and of this total about 50 per cent. consisted of induction and synchronous motors and two 450 k.w. rotaries on direct current service. On the chart herewith it is not possible to detect the starting at about 6 p.m. of two 400 h.p. 4,000 volts synchronous motors which were used to drive arc lighting machinery.



On a high head plant the problem of regulation is a more difficult one to solve, and I send you herewith a chart off a substation in which we step down from three water power stations, one with 450 feet head and the other two about 360 feet each. From this we handle motor and lighting load, but the regulation is bad and very detrimental to incandescent lamps. It should be added that off this same system are operated rotaries supplying railway load. It might help the regulation to install a storage battery, but just as you point out in your editorial, it is now most advisable and the cheapest to install large steam direct connected units to give proper regulation as well as additional and more reliable power.



We have three water power plants and three transmission systems, 37 miles, 16 miles and 14 miles respectively, all working in multiple, and, outside of lightning and the "malicious boy" with the "baling wire", we have very few interruptions.

It thus comes down to the point of giving our now large number of power users a perfect and uninterrupted service. Therefore, at the present time a steam auxiliary must be put in, and, later on, additional water power developed.

Yours truly,
O. A. HONNOLD,
Formerly with the Lachine Rapids Hydraulic and Land Co.,
Montreal, Canada.

ELECTRICAL APPLIANCES IN THE DOMINION IRON AND STEEL WORKS.

The flexibility and adaptability of electricity and electrical apparatus is such that it has come into use for an almost infinite variety of purposes. It is therefore quite in order to learn that it is playing a most useful and important part in connection with the extensive works of the Dominion Iron and Steel Company at Sydney, Nova Scotia. By courtesy of the company, a representative of the ELECTRICAL NEWS was given the privilege of inspecting the works, in company with Mr. Boyd, chief electrician and assistant mechanical engineer, to whose kindness our readers are indebted for the following particulars concerning the electrical features of this great iron-making plant, which is destined to assume still larger dimensions, and is already giving a great stimulus to business in the Maritime Provinces :—

In connection with the coke ovens there are four elevators. Two have each three D. C. 220 volt multipolar series wound C. G. E. motors. One of 40 h. p. is used for conveying the crushed coke to the top of the elevator; another of 15 h. p. drives a belt conveyor which carries the coal from the top of No. 1 to No. 2 elevator. A 75 horse power motor is used to operate the coal crusher.

THE COAL WASHING PLANT.

In connection with this part of the plant there are employed nine direct current 220 volt shunt-wound C. G. E. motors—two of 75 h. p. each are used for crushing the lump coal, and conveying it to the shaker screens; two of 30 h.p. are employed in pumping water for washing the coal; two of 30 h.p. each for operating the shaker screens; one of 30 h.p. for running the jigs and conveying the dirt out to the dump; three of 15 h.p. each in conveying the washed coal to the top of a series of elevators at the coal washing plant.

The coke ovens have four pushers, on each of which are two motors—one 45 D. C. 220 volt multipolar shunt-wound Westinghouse for pushing the coke out of the ovens and another for traversing the pusher. There are also two charging cars at the ovens. Each of these cars has four Westinghouse motors—one of 40 h.p. D.C. 220 volt shunt-wound for charging the ovens and traversing the car, one of 5 h.p. for stamping, and two of 5 h.p. each for running the belt conveyor.

THE FURNACES.

There are five furnaces. Each has a scrap conveyor controlled by a 30 h.p. 220 volt, D. C. shunt-wound Westinghouse motor. There are also five scale cars, one being used for each furnace. Each car is operated by a 30 h.p. 220 volt series motor. The cars are used for handling ore, coke and dolomite, and for dumping same into the skip hoist buckets, which are then conveyed by hoists to the top of the furnaces and there dumped. There are three ore bridges to convey the different ores to the pockets. The buckets on each bridge are operated by two 80 h.p., 220 volt direct current compound motors. When these motors are causing the buckets to scoop there is quite an intermittent load, sometimes requiring as high as 800 amperes.

At the crusher building connected with the open hearth building, there is a 100 h. p. D. C., compound-wound shunt motor for running a series of crushers, and in connection with the pig machine there are also three motors--one of 50 h.p., 220 volt multipolar, D.C. series wound, for hoisting and pumping the iron into pans that form the pigs; one of 25 h.p. for removing the stirrups from the ladles; and one of 50 h.p. for running the series of pans and dumping the pigs on cars.

THE OPEN HEARTH BUILDING.

This building is equipped with two 75 ton electric cranes. Each has one main 60 h. p. bipolar 220 volt D. C. Westinghouse motor; one 30 h. p. Westinghouse four-pole motor for traversing, together with an auxiliary hoist controlled by a 45 h. p. four-pole D. C., 220 volt series wound motor and a 5 h. p. ditto for traversing. There is also one 45 h. p. 220 volt D. C. multipolar series wound motor used for traversing the bridge. The main hoist is used for lifting 100 tons of steel in vessels to be poured into moulds, the vessels being emptied by tap holes in the bottom. The auxiliary hoist is employed for dumping cauldrons of metal into the furnaces while the ladles are suspended from the main hoist stirrups. This metal is afterwards mixed with ingredients to form steel. Each ladle weighs about 15 tons and holds 80 tons of metal.

A Wellman & Seaver charging car is employed for charging the furnaces with scrap. On this car there are three D. C. 220 volt series Westinghouse motors—one of 5 h. p. for turning the ram which empties the car of scrap into the furnace; one of 30 h. p. for pushing the ram into the furnace; and one of 30 h. p. for travelling. The controllers on the car are of the Dinky type manufactured in Cleveland. They are subjected to very hard usage due to the rapid changes in direction.

Each furnace has a ventilating fan driven by a 5 h. p. 220 volt multipolar D. C., C. G. E. shunt motor. Difficulty is found in securing the right kind of men to operate the charging cars. The position is one which requires remarkably quick action.

The stripping building, which contains the machinery for lifting the moulds off the ingots, is operated hydraulically.

THE BLOOMING MILL.

In this mill there is a scrap conveyor for carrying the scrap ends of billets from the shear table to flat cars. This conveyor is operated by a 30 h.p. series motor. The mill is also equipped with two 20 ton Morgan cranes used for placing the ingots in the soaking pits, and also for putting them on an ingot buggy run by a 30 h. p. motor which places them on the conveyor, to be rolled into billets. These ingots when placed on the conveyor are about 6 feet in length and are rolled out to a length of 136 feet. On each of the cranes there are four motors—one of 50 h. p. to raise and lower; another of 5 h. p. to open and close the tongs which hold the two ton ingot; one of 5 h. p. to run the trolley from side to side; and one of 30 h. p. to operate it to and fro. These are series motors of the Westinghouse type, 220 volt D. C. The main engine which operates the rolls of the blooming mill is a 1,250 h. p. reversible McIntosh, having cylinders 52 inches in diameter and pistons of 6 inch stroke.

MACHINE AND REPAIR SHOPS.

In connection with the works the company have a splendidly equipped and arranged machine shop. Such of the machines as must be operated to a large extent independently are run by individual motors, while those which operate continuously are driven by belts from a shaft operated by a 90 horse power motor. The shop is equipped with a 20-ton electric travelling crane, by means of which all the handling of heavy machinery is done. In the foundry adjoining the machine shop there are also two 15 ton cranes connecting with the machine shop. A 30 h.p. direct current motor is used to operate the fan for the cupola and to work an air compressor, which in turn operates drills in the billet yard. Air at 80 pounds pressure is used for various purposes throughout the plant.

In connection with the machine shop there is also a well equipped electrical repair shop in which is done all winding of armatures and fields and assembling of motors from core to body. All repairs on controllers, arc lamps and commutators are done here, as well as the making of all spare bearings for motors. A good supply of interchangeable parts is kept on hand with which to fix break-downs. The winding lathes and gear cutters are operated by separate C. G. E. motors.

STORAGE BATTERY FOR RAILWAY WORK.

It may not be generally known that the Berlin & Waterloo Street Railway Co. have in operation an 80 ampere storage battery manufactured and installed by the Gould Storage Battery Co., of Depew, N. Y. It consists of 255 type O 5 cells in glass jars, each jar containing two positive and three negative plates, the jars being of sufficient size to admit of 50 per cent. increase in capacity of battery. A booster of 65 volt 100 ampere capacity supplies difference in voltage pressure to facilitate charging of the battery. The battery is capable of supplying 160 amperes for short periods of peak of load, and is now set and working satisfactorily at the rate of maximum discharge. It is in circuit with the generator (100 k. w., with an additional one of the same capacity for emergencies), and in the manner indicated provides for fluctuations of load, thereby greatly easing the generator and engine.

With use of battery alone, all producing machinery stopping, the company have run one car continuously for four hours on their main line, which has maximum 4 per cent. grades, and at end of that time the indicators showed the battery to be easily capable of continuing for two hours more. Sunday morning cars are operated from the battery alone.

It is understood that the British Columbia Electric Railway Company intend to greatly increase the rolling stock of their road, and that the new cars will be built in the company's own car shops now in course of erection at New Westminster. The cars will be 22 feet in length, of the standard width, and will have seats facing forward instead of lengthwise. Upholstery is to be done away with as being unsanitary, the cars being finished in polished oak.

The Lindsay Light, Heat & Power Company are duplicating their plant at Lindsay, Ont., as a result of the rapid increase in their power and lighting business. When completed they will have about 1,200 horse power available for transmission from their power house at Fenelon Falls. A complete duplicate is being made of water wheels, generators, step-up and step-down transformers, switch-board apparatus and pole line, so as to enable the plant to be operated in unison or separately, as occasion may require, and at the same time reduce the chances of a stoppage of the system to the minimum. This company have adopted the meter system entirely.

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AND
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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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Directors Please Note.

The income of all our operating companies in Canada, railway, light and power, of necessity has to be obtained from the territory in which they operate, the earnings of each rising and falling coincident with the increased or decreased prosperity of its customers; in short, the companies are entirely dependent upon those immediately surrounding them for the wherewithal of their dividends. This being the case, should they not express their appreciation of the fact by making promotions in their various staffs, as opportunities occur, from among their own men, Canadians, who have put in many hard and weary hours on the lower rungs. It does not add to the value of a junior's services if he is led by examples in other places or by bitter experience in his own company, to feel that when a good position offers itself he is more than likely to be passed over in favor of a man, perhaps far from being his equal, who hails from across the border, but this is, alas, too often the case. There are a great many young men in this country, Canadian born and bred, who are the equals in every way of their competitors from the States. When the next vacancy occurs on your staff, even if it be that of Superintendent or Manager, give one of them a chance; we do not doubt for a moment but that the results will amply justify the giving of the opportunity.

Starting Synchronous Motors.

As is well known, the synchronous motor, which is under a great many conditions a most satisfactory machine once it is running and connected to the line which supplies it, is very hard to start, especially in small systems or in those cases where it is fairly large compared with the generator, on account of the heavy currents which it demands from the line, blowing fuses, and dropping the voltage all over the line, not infrequently to an extent sufficient to make other motors already running drop out of step and thus further complicate matters. To obviate this difficulty there are two methods of starting which are in general use today, namely, that of using a starting motor of the induction type, and that of placing in the circuit a compensator, or auto-transformer. Each has its own merits and each its own disadvantages, though if the synchronous motor cannot be disconnected from its work, or the major portion of it, by clutches or fast and loose pulleys, the former method is usually the most satisfactory. The induction motor is sometimes built direct connected to the other, the two armatures being on the same shaft, in which case the starting motor has to revolve all the time the main machine is running. This plan has the advantage in simplicity and noiselessness, but the starting motor is comparatively expensive, as it has to be of a speed which for its size is classed as slow. The alternatives to direct connection are belting and gearing, and occasionally a friction drive is found, though the latter has not proved itself a great success and is now being discarded. The belted machines are arranged in some instances to run coincident with the synchronous motor, no clutch or loose pulley being installed, though it is possible to throw the belt off completely, but in the majority of cases, where this drive is adopted one or the other of these devices is put in. For driving by gearing the best machine cut gears must be used, properly guarded to prevent injury to attendants or the apparatus. The two machines are disconnected either by making the pinion to slide along the shaft until out of mesh, or by introducing an idle gear, which swung on the end of an arm and controlled by a lever working over a quadrant, serves to connect or disconnect the pinion on the starting motor and the gear on the main machine according as it is swung into or out of mesh with them. Another method is to mount the starting motor on a base which can be raised or lowered as desired, the pinion thus being engaged with or freed from the gear at will.

Exciter Driving

The question of providing satisfactory methods of driving the exciters for moderate-sized alternating current generators, without incurring excessive expenditures, is always a live issue, and the methods evolved for its solution have been many and varied. The first choice which has to be made is between separately driven units, equipped with a water wheel or engine or other driving power distinct from that which operates the alternator itself, and that type, belted geared or direct connected, which is driven from the same prime mover as is the machine which they excite. The latter as a rule are the cheaper, especially when the increased cost per horse power of the small machine which drives it is taken into consideration, but on the other hand, especially in plants with unusually large load variations, they are open to the serious objection that any change in this factor produces much larger voltage variation than would be the case if the exciter were separately driven, due to the fact that its speed and voltage varying simultaneously with that of the alternator, the latter gets less excitation than normal just at the instant it needs more, namely, when the load having suddenly become heavier, its speed is, momentarily at least,lower and the armature reaction greater. Exciters driven by separate water wheels are very satisfactory, though in systems operating under extremely high heads difficulties are sometimes experienced with the wheels choking up, as under the conditions of high head and small power the nozzles are very small, and but little debris is necessary to clog them. This difficulty has been overcome by adding to the unit an induction motor which is mounted on the same shaft as the other two machines, and is at all times connected to the main bus bars. If the wheel fails from any cause the motor still keeps the exciter going; if part of the load comes off the latter and the wheel tends to race, the induction motor prevents anything but a small increase in speed by acting as a generator and delivering energy to the bus bars. When the two machines are driven from the same source of power direct connection is most satisfactory, though the exciter is somewhat expensive, especially for steam plants where the speeds are low.

Next in point of desirability comes the belt drive, gearing being unsatisfactory on account of noisiness and rapid wear. Rotary converters and motor driven machines are sometimes installed—they both necessitate the presence of a running machine other than the one they excite, or some other independent source of E. M. F., otherwise the plant cannot be started, and in addition the former is open to the objection that any change in the generator potential means a corresponding change in that of the exciter, as the relation between its A. C. and D. C. sides is fixed, when the alternator needs a higher exciter voltage, that is, when the load has increased and reduced its terminal pressure, it receives a lower voltage, and vice versa. In steam plants the method of driving the exciter by its own engine is extremely satisfactory, although the steam consumption per horse power is somewhat higher than if the exciting power were generated by means of the large engine, which is sometimes named as the reason for the installation of motor driven sets. The situation may be summed up thus: Separately driven units are almost always to be preferred, motor driven sets are superior to rotaries, direct connection is more desirable than belting or gearing.

Single Phase Railways

The announcement is made that the Westinghouse Company have closed a contract calling for the equipping of some 55 miles of railway,between Washington and Baltimore, with a branch to Annapolis. The generator and transmission lines are to be alternating, as is common practice to-day where the distances to be covered extend over any considerable length, but instead of being multiphase, they will be wound for single phase currents only, a somewhat unusual feature, and when it is further noted that the motors in the cars are to be alternating and single phase at that, it will at once be recognized that if successful this installation will make a tremendous advance in the interurban railway field. The characteristics of even polyphase induction motors with regard to their starting torque, starting currents and efficiencies under partial speeds,have hitherto prevented their introduction in the railway field of this continent, though they have been used to a certain extent in European practice, and so we have been confined to direct current machines, the commutators of which have limited line potentials to the neighborhood of 500 volts. It will at once be recognized what a large saving will be effected by the new system in line copper alone when we are told that the potential on the motors is to be 1,000 volts. Further than this there is the great advantage that, the system being single phase, there will be only one trolley wire and its accompanying current collecting devices, the rails being utilized, as in direct current work, as the other conductor. The transmission to the substations, which will contain nothing but static transformers, and thus be much less costly than the standard rotary converter substation, will be at a potential of 15,000 volts, the transformers reducing this to 1,000 volts, at which pressure it will be delivered to the trolley, as stated above. The present intention is to mount four 100 h.p. motors on each car, which will weigh complete between forty and fifty tons, the equipments being figured for a speed of about forty miles per hour. The details of the method by which a single phase motor is made to give a performance hitherto unattainable even from multiphase apparatus, the particulars of the system of control, weights, efficiencies, etc., have not yet been made public ; these, and to a greater extent the results of actual operation will be looked forward to by railway men the world over, as if the undertaking prove a commercial success, and the standing of the Westinghouse Company goes far to ensure that it will, electric traction will be in a better position than ever to demonstrate its pre-eminence as the motive power of the future.

THE ROBB ENGINEERING COMPANY.

The Robb Engineering Company, of Amherst, Nova Scotia, are about to make extensive enlargements and improvements to their works. This step has been made necessary by the rapid growth of the business, the volume of which has nearly doubled within the last two years. It is proposed to erect next year a new machine shop 100x250 feet in size, and to rearrange the other departments to the best advantage, placing the buildings so as to permit of their further extensions when necessary. The machine shop, boiler shop and foundry will be equipped with travelling cranes. A new electric plant will be installed to operate these cranes and many of the machines in the boiler and machine shops, as well as to light the works.

Ouiatchouan Falls, Near Lake St. John, Quebec.

A walk through the works reveals the fact that the management is actuated by progressive principles. Every device calculated to reduce the cost of manufacture and render more perfect the product, is eagerly sought for and adopted. In some instances where a suitable device could not be found to perform a certain kind of work, the inventive genius of the firm has proved equal to the emergency. One of the latest of these inventions is the Robb-Armstrong Sweet governor, patents for which have been applied for in Canada, the United States and Europe. This new governing device is said to embody the advantages of the Sweet and Rice inertia governor and is so designed as to avoid friction.

The company have a most excellent system of preserving for ready reference the details of manufacture and tests of each engine turned out, so that any future troubles in operation can be promptly and certainly remedied.

Electric, hydraulic and pneumatic power are employed in the works, the first for lighting and power, the second for operating the heavy drills, and the third for operating the lighter drills, these latter being attached to flexible hose filled with compressed air, and thus made available for use at any place inside the shops or even outside.

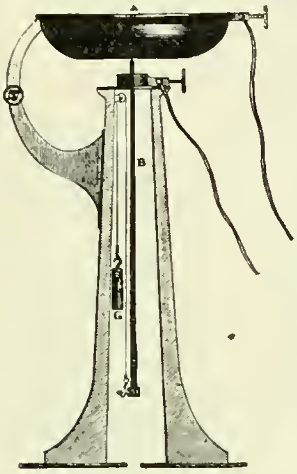
The company have now nearly ready for shipment four engines for the Trinidad and one for the Demerara electric railways. They are each of 45 h. p. capacity. Last year they were honored by receiving an order from the Technical School of Manchester, England, for an engine which should exemplify the best features of American design and construction.

DEVELOPMENT OF ARC LIGHTING APPARATUS FROM 1810 TO 1902.

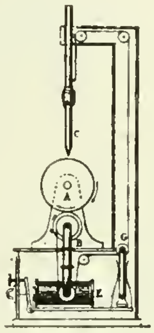
By W. D' A. Ryan.

(Continued from last month.)

In 1879 Werdermann of London introduced an incandescent Arc Light, in which the end of a small carbon pencil was pressed in contact with a large block or disk of the same material. A sufficiently heavy current was passed through the lamp to cause the small carbon to become incandescent. Occasionally a bad contact would cause a sputtering arc to form between the end of the small carbon and the block, but usually there was no arc at all. The efficiency of such a light was very low, and for this reason the Werdermann, Harrison and several lamps of this type met with little success.



Werdermann's Lamp.



Harrison.

In 1879 Andrews, of England, attempted to get a long life from an electric candle by using large plates of carbon in place of rods. The arc was established by a stepping-stone igniter on the side of the carbons. This lamp was not successful, principally because the arc when any distance whatever from the edge of the carbons was almost entirely obscured.

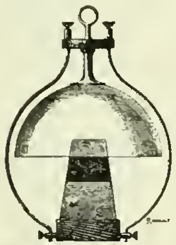


Fig 460

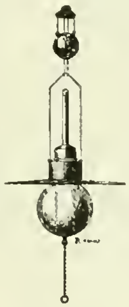
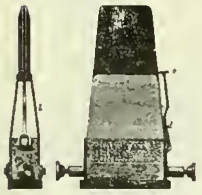
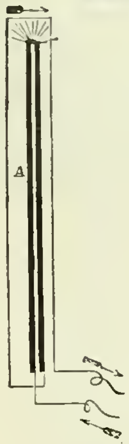
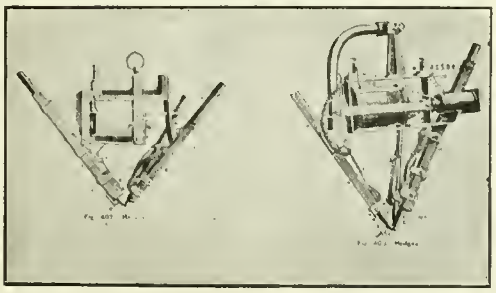


Fig 462.

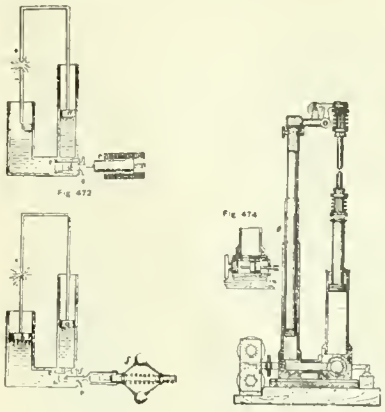




In 1879 Jamain brought out his blow-pipe candle in which he made use of the attractive effect of the current to draw the arc up from the ends of the pencils in a fan shaped flame. He arranged a piece of marble, chalk, or lime so that the flame impinged thereon, thus producing a white light similar to the Oxygen-Hydrogen lamp. The candle was never developed to a point where it was considered practical.

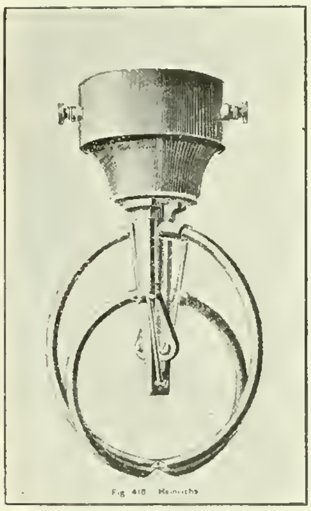


1879
Hedges
London.



Sedlackek and Wikuhll.

1879. Sedlaczek & Wikulilli. This is a peculiar type of lamp designed especially for locomotive headlights. The motion of the carbons is controlled by pistons floated in liquid, the feed being actuated by a magnetic or centrifugal governor. The principle was supposed to obviate the jar from the locomotive on the carbons. The lamps proved to be of little practical value.



In 1879 Heinrichs, of London, designed a peculiar lamp in which the position of the arc was determined by the coincidence of the axis of curved carbon pencils. These lamps could be run in series, but owing to the expense of making carbons of this shape and to the unsteadiness of the light, the lamp met with little favor.

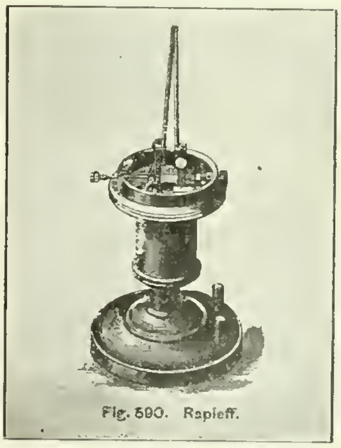
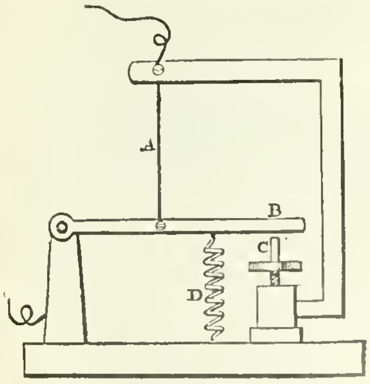


Fig. 590. Rapieff.

1897. Rapieff, London, designed a candle similar to the Wilde except that the carbons were much longer.



Edison's Platinum-Iridium Lamp.

1879. Thomas A. Edison constructed a lamp in which a wire composed of platinum and iridium was run at a high temperature. The efficiency of this wire increases very rapidly as the temperature approaches the fusing point. The lamp shown is arranged so that when the wire has almost reached this point its elongation will cause it to cut itself out of circuit. On slight cooling the contraction will re-establish current through the wire. This apparatus while quite efficient could not be made sufficiently sensitive to avoid destruction of the wire. It was therefore abandoned.

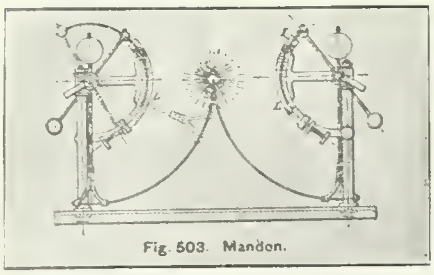


Fig. 503. Mandon.

In 1880 Mandon of Paris invented a novel type of lamp consisting of two quadrant electrodes balanced by counterweights rotating around fixed centres. Curved tubes containing mercury supported floats which raised the carbons as they were consumed. Ingenuity was the chief merit of this lamp. It had no practical value.

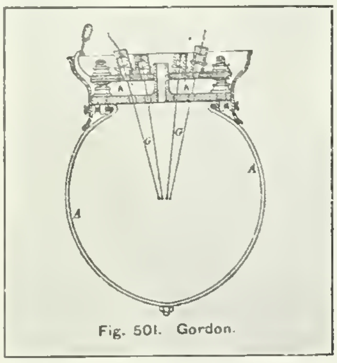
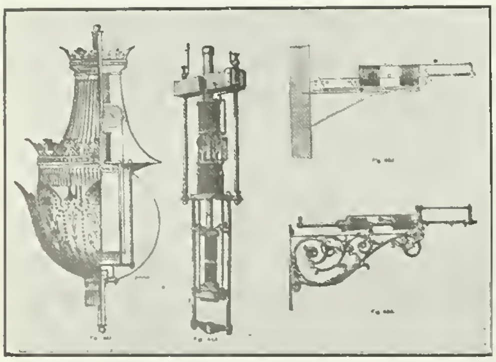


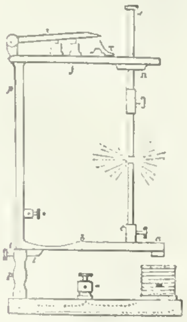
Fig. 501. Gordon.

In 1880 Gordon of England invented a lamp in which the light was produced by rapidly alternating currents of high tension, discharged between knobs of refractory metal which became heated and emitted light.

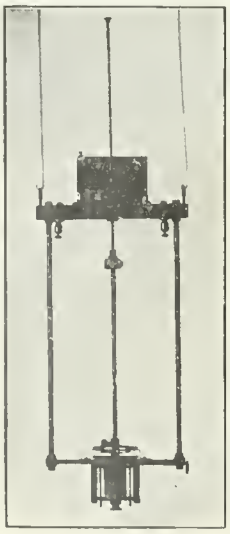
The efficiency was very low and the light was of a bluish tinge. In 1880 and 1882 Krizik & Piette of Austria introduced the Differential Pilson Lamp in both the vertical and horizontal types. The former was provided with plate carbons for long burning. The horizontal type was designed for use in rooms having low studded ceilings. The latter construction necessarily introduced a large element of friction and must of necessity have been more or less sluggish. This feature would have been sufficient to prevent the lamp meeting with any marked encouragement.

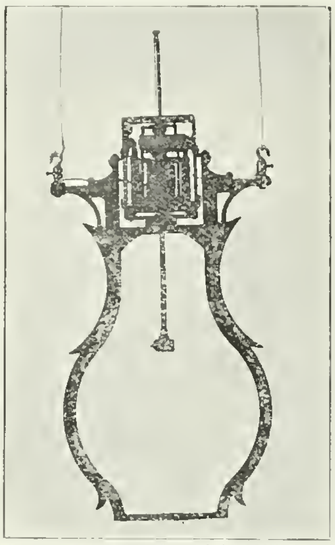


We will now depart from the European development entirely and confine our attention exclusively to progress in America, reviewing a few of the principal steps which lead up to the great success of both the Thomson-Houston and the Brush arc lighting apparatus which has established a world wide reputation. About 1878 Professor Elihu Thomson invented a lamp with current interrupter attached to the lower carbon, the object being to break the circuit many times per second so as to produce an inductive kick from the dynamo and line which would maintain an arc with a very feeble current. In 1878 this was followed by a shunt feed lamp in which the arc was established by a series magnet, drawing down the lower carbon, the upper carbon being held by friction wheels the pressure of which was released for feeding by a small relay. Only one lamp could be run on a machine.

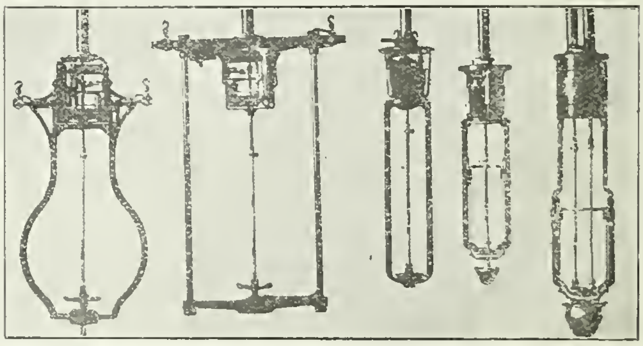


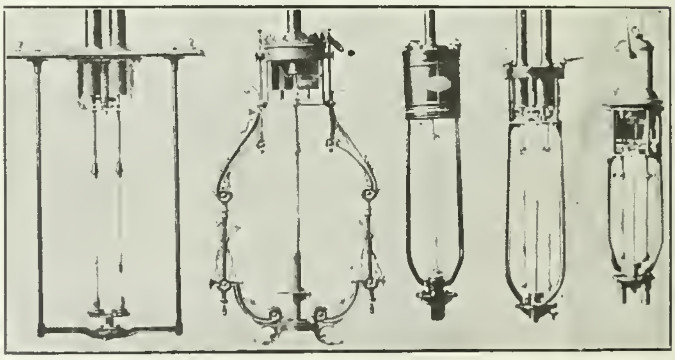
Thomson-Houston Lamp.

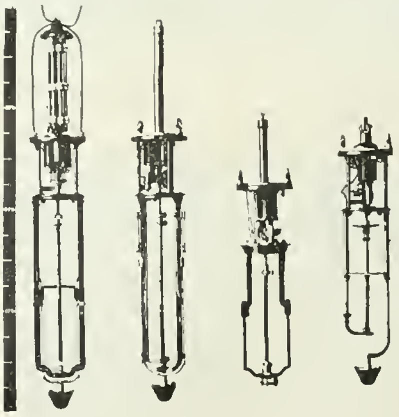




In 1880 the same inventor introduced a lamp having a series magnet in the upper part for establishing the arc. The top of the carbon rod was grooved so that when the carbons were nearly consumed the rod would drop through the clutch and short circuit the lamp, thus allowing the current to pass through the short circuited carbon tips and on to the other lamps in the circuit without interruption. Any number of lamps could be run in series. This was quickly followed by several designs of both differential and shunt Thomson-Rice Lamps with which many of you are no doubt familiar. A similar line of development was simultaneously carried on by the Brush Electric Company. The general tendency of both companies to reduce the diameter of the lamps, and the introduction of two carbons to give a longer life, is clearly shown in both cases. Single carbon lamps had a life of 8 to 10 hours and the double carbons from 16 to 20.







In 1892 and 1893 lamps were designed for operating on multiple lines commonly known as incandescent and power circuits. The Thomson '93 was one of the class. It was a very close regulating lamp and was unsurpassed for steadiness and brilliancy.

The first of these lamps were designed to run two in series on 110 volt direct current circuits, each arc taking about 45 volts, the balance of the voltage being taken by a current steadying resistance installed in the top of each lamp.

So successful were the results that this line of lamps was immediately extended to alternating and direct current, series and multiple circuits representing all classes of service. The excellent quality of the light given by these lamps was due in a great measure to the use of high-grade carbons which cost from $30 to $40 a thousand, and a single pair had a life of about ten hours. The maintenance was therefore very high and furthermore the lamps were not adapted to individual control. As previously stated, two lamps were installed in series on 110 volt Direct Current Circuits so that when one lamp was turned out the other also was extinguished. In the case of railway circuits where ten lamps were run in series a cut-out was a necessary adjunct to lamps for this service and its function was to cut in a compensating resistance to hold current down as the arc went out so that the power consumed was constant independent of the number of lamps burning.

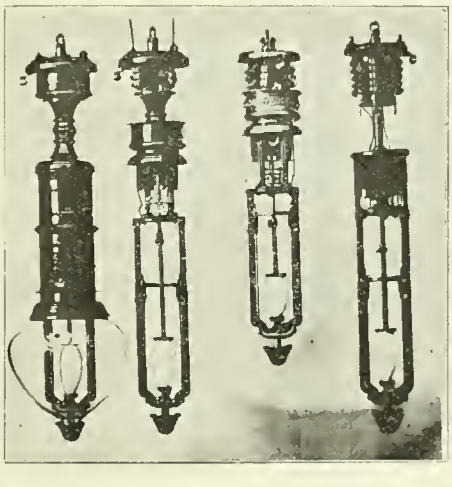
In the early part of 1894 simultaneous attempts were made by many engineers to resurrect some of the early unsuccessful laboratory experiments to construct a practical lamp which would burn 100 hours or more on a single carboning with the object of affecting economy in the cost of care and maintenance. It was also desirable to run the arc voltage much higher than would be possible in open air in order to accomplish the feature of individual control. Some early attempts were made to operate a Thomson '93 lamp with a small globe surrounding the arc. A cap was placed on the top of this globe and the upper carbon passed through a hole having a small clearance, thus practically excluding the oxygen and arresting consumption. While the life of the carbons was increased from 10 to approximately 100 hours, many difficulties were encountered. The carbons were not sufficiently homogeneous or pure to burn steadily without depositing a large amount of impurities on the globe; furthermore, they were usually more or less crooked, cracked or blistered, and varied in diameter at different sections throughout their length. Feeding such carbons through a hole of small clearance was accompanied by unsteadiness in the light and frequent interruptions.

Furthermore, the art of enclosing globe manufacture had yet to reach a high stage of perfection. The glass usually varied in thickness and was not properly annealed, so that the breakage due to unequal stresses in the glass was great. This feature accompanied by the heavy deposit formed on the globes from the impurities of the carbon were obstacles which made lighting by the enclosed arc method seem almost impractical.

Pressure was at once brought to bear upon the globe manufacturers as well as the makers of carbons which resulted in a decided improvement in both directions, thus offering sufficient encouragement for bringing out lamps designed especially for long burning.

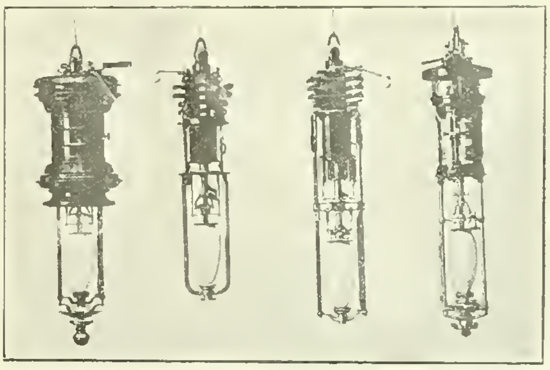
Thus from the beginning the successful development of arc lamps has depended upon the production of suitable carbon to use in them, and independent of any advance which might have been made towards the construction of suitable lamps for enclosed arc lighting such lamps would have been just as useless with the best carbons made ten years ago as a locomotive would be without steam.

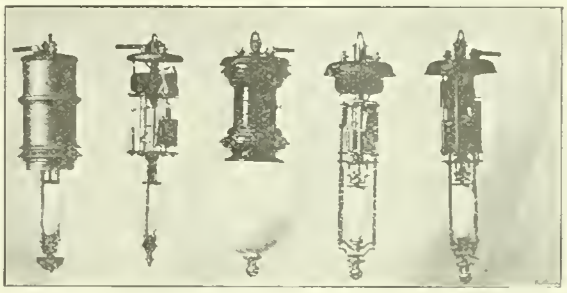
While the first step towards enclosed arc lamps brought out a wonderful simplification of the mechanism, little was done towards improving the aesthetic qualities and the lamps were just about as long and cumbersome as the open arc lamps which they were so soon to supersede. Just so long as the carbon rod remained the lamp could not be materially shortened, but during the years of 1896 and 1897 some manufacturers in an attempt to get a short lamp abolished the carbon rod and allowed the clutch to act directly on the carbon pencil. This was an exceedingly venturous step at the time; notwithstanding that carbons had undergone a wonderful improvement to accommodate them to the long burning feature, they were still far from perfect and many troubles were experienced in trying to work the clutch directly on an uneven surface.

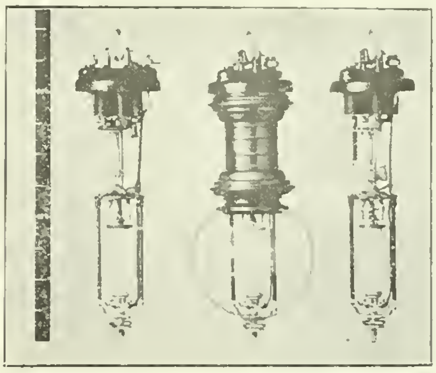


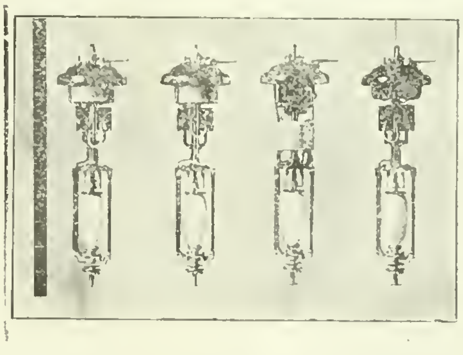
It was not long, however, before the carbons underwent a further improvement, and were made practically free from cracks or blisters, were straight, and did not vary more than .015 to .020" in diameter, so that there no longer existed any question as to the possibility of satisfactorily operating a clutch directly on the carbon. In fact, all modern lamps are now constructed on this principle. The earliest direct current lamps were of the solenoid type, which were difficult to insulate and somewhat troublesome to assemble and keep in alignment. This usually resulted in a variable friction.

About 1897 construction dropped back to the electro-magnetic principle used in the first enclosed arc lamps having carbon rods such as the Marks-Ayer, early General Electric and others. This seems to be the most substantial mechanical construction. Lamps of this principle are used on all forms of direct and alternating current, series and multiple circuits. Practically the only difference between the direct current and the alternating current multiple lamp is that the former uses two solid carbons and has a dead resistance for steadying the arc and regulating the voltage, while the latter burns one cored and one solid carbon and has a laminated armature, and a reactance is substituted for the dead resistance. Electric arcs are a little more sensitive to alternating current than direct, owing to the rapid interruption in the former. The reactive coil has a steadying property not possessed by a dead resistance. This gives the lamp a good margin of stability beyond the chattering point; furthermore, it is less wasteful of power.









Before concluding the subject of arc lamp development I would like to add a word or two on a few of the essential features to be carefully regarded in modern arc lamp engineering, which class of engineering is quite, if not more, difficult than any other branch of electrical work. A 100 light dynamo might possess faults which would or would not be apparent to the dynamo operator, but the 100 lamps spread over a large territory and operated by this machine would be open to the criticism of every body in the vicinity, including every policeman on patrol, who usually seem delighted to carry back to the police station a report that such and such a lamp chattered or went out. This usually means a reduction in the lighting company's bill of so much per light out, as covered by many lighting contracts. The lamps are therefore open to the criticism of the public, while the machine is open to the criticism of an individual or two; further, if the fault in the dynamo is of such a nature as to show itself in the lamps, the latter will come in for the blame anyhow.

In the development of modern arc lamps the engineer is required to give careful attention to the following points:—

First:—Aesthetic.—The lamp in general design and contour must be symmetrical, well balanced, and pleasing to the eye. Extremely broad or very slim design should be avoided and features of difficult design or manipulation in production should not be introduced.

Second.—Ventilation.—While adhering to the point just mentioned due regard should be given to the ventilation, so as to allow proper convexion and radiation of the heat dissipated in the arc and lamp coils.

Third.—Mechanism.—This should be as simple as possible, due care being given to modifying the design so as to have the smallest number of movable parts, thus avoiding friction which is more or less in evidence in all lamps and should be minimized as far as possible, consistent with substantial design.

The magnets and their armatures should be so proportioned as to give an even pull throughout a wide range in order to maintain the voltage in the case of series lamps and current in the case of constant potoential lamps practically constant.

The wire used in the coils should be sufficiently liberal in its cross section to avoid overheating. Small diameter coils are to be preferred to thick ones, as the latter hold the heat and the temperature of the inner layers of the thick coils rises to a much higher degree than those having a smaller depth of wire.

In alternating lamps the magnetic parts should be of high permeability and properly laminated, so as to reduce the heating by Foucault and Eddy currents, and provision must be made for taking up the rapid vibrations of the armature core in a way to avoid undue humming.

There is an inherent hum in the arc which it is impossible to avoid, but by proper design the humming of the cores and rattling of the mechanism can be almost entirely obviated.

The dash pot, a necessary adjunct to all lamps, is a feature of considerable importance. Without this the lamps will not start well and will be liable to chatter or surge on series currents.

Under certain well balanced conditions a lamp will operate without a dash pot, but it has not been found practical in any design so far attempted to do away with it entirely.

The strength of this dash pot must be so proportioned that it will start the lamp without a momentarily excessive rush of current, which always follows when the dash pot is too stiff.

In the same direction we have the mechanical danger of having the plunger fit too tightly in the shell and it is liable to stick.

On the other hand a weak dash pot will cause excessive chattering when the lamp starts, and it is considerable of an engineering problem to strike the proper point midway between the two evils; furthermore, owing to the constant heating and cooling of the lamp the dash pot shell frequently loses its original shape and binds.

If the engineer has had sufficient experience he will know how to make these dash pot shells so that they will be reasonably permanent in shape by giving great care to the composition of the metal selected and to the temperature at which it is worked and the method of mechanical manipulation. Plungers have been made of brass, phosphor-bronze, German silver, carbon, graphite, soap-stone and various substances. In all cases it has been found that two dis-similar metals work better together.

All the above metals have their advantages and dis-advantages, but an especially prepared form of graphite has been found to be the most reliable. At least this is the decision arrived at by a leading manufacturer based on the merits of operation of over 300,000 enclosed lamps, in fact, if I include the open arc lamps, I might safely say 700,000.

The clutch should be extremely sensitive and at the same time positive in action so that it will feed on a small variation in voltage and at the same time will not permit the carbons to slip through under excessive jarring.

The carbon holders should be carefully designed, and the method of carrying current to these holders should be flexible and positive and the leads should not be liable to entanglement with other parts of the lamps.

Trimming should be simplified and all parts should be substantial so as to stand fairly rough handling, if the lamps are unfortunate enough to receive it, and they usually do.

The insulation should be concentrated at the fewest possible points and should be reasonably high and all external parts of the lamps should be dead.

It is also very important that the design permit of easy alignment. And further it goes without saying that a lamp which cannot have a small part repaired without tearing it all to pieces is hardly to be considered at this period.

While endeavoring to maintain all the above features at the highest degree of excellence, the manufacturers in their work of simplification and improvement have given due care to manufacturing lamps of various types as similar as possible in design consistent with the various classes of circuits on which they are to be operated. This is of the utmost importance to central station men, as the lower frames, tops, centre tubes, globes, carbon holders, etc., can be used on any of the different types and by slight modifications any one of the lamps can readily be converted for use on any of the various circuits.

While it has cost thousands of dollars to mould the different lamps into similarity, yet this cost to the manufacturer has been offset by a material reduction in the cost of production owing to the greater number of similar parts which can be manufactured at one time, thus greatly facilitating handling of stock and the distribution of parts to the various departments employed in the manufacture of apparatus.

The advantages from this important achievement of modern arc lamp engineering have been manifold and all have benefitted thereby.

Mr. Ryan supplemented the above paper by a brief treatment of the "Relative Merits of Open and Enclosed Arc Lamps", illustrating the various points with candle power and illumination curves. The lecture was concluded with a number of experiments with light by the use of such instruments as the polariscope, spectroscope and other projection apparatus.

PRICES FOR ELECTRIC CURRENT IN GERMANY.

Light and power are delivered by the Actiengesellschaft Elektricitats, Hagneck, Switzerland, station under the following conditions:

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	10 C.-P. Fcs.	16 C.-P. Fcs.	25 C.-P. Fcs.	32 C.-P. Fcs.
More than 1,000 hours per year.	13.50	21	33	42
400 to 1,000 hours per year....	10.50	16	25	32
400 hours per year............	7	10.50	16.50	21
With motors, minimum rate ...	2. 0	4.50	7	9

Rate for use, 0.35 Fc. per kilowatt-hour.

TARIFF FOR ARC LAMPS.

Pressure about 35 volts.

135 Fcs. per year and per lamp of from 10 to 12 amperes.
180 " " " " 15 " 17 "
225 " " " " 20 " 22 "

TARIFF FOR ELECTRIC MOTORS.

Class A, applicable to motors operated eleven hours per day.

1/10 h.-p., Fcs. 270 per h.-p. and per year, Fcs. 27.00
1/4 " " 245 " " " 61.25
1/2 " " 225 " " " 112.50

One to 100 horse-power and more according to contract.

Class B, applicable to motors operating continuously day and night.

The prices mentioned above, with an increase varying up to thirty per cent. according to the duration of the work.

Class C, applicable to motors operating only during the day, and not during the hours of lighting.

The prices given above with reduction of thirty per cent.

Class D, applicable to motors not included in the former classes—motors operating with great changes of load, railway motors, etc. Special agreements are made in each case in consideration of the character of the work.

TESTS OF A HIGH TENSION SWITCH.

Some interesting tests of a high tension switch were recently made at the Colgate power house of the Bay Counties Power Company, in Yuba County, California. A single-pole switch was connected directly across the 40,000-volt bus-bars that were receiving current from generators having a rated capacity of 7,500-kilowatts through transformers of equal capacity. This switch was closed and opened ten times in the space of two minutes and it opened the dead short circuit each time safely and easily and without damage to the switch, transformers or lines.

One of the two bay lines that were in parallel was then cut out at Colgate, but left in parallel with the other at a station 120 miles from Colgate, and the switch connected across this line, thus giving 240 miles of line between the switch and bus-bars. The switch was closed and opened fifteen times in the space of three minutes, and it opened the short circuit each time safely and easily and absolutely without damage to transformers or lines. The switch opened the short circuit the twenty-fifth time fully as well as the first time, and was not at all damaged by the extremely severe test of opening a dead short circuit at 40,000 volts, with generator and transformer capacity of 10,000 horse-power behind it, twenty-five times.

The Slade Electric Company, of Quebec, are installing electric light in the Roman Catholic church at Sillery. The same firm have just completed the installation of 2,500 lights in the Chapel of the Ursulines, Parlor street, Quebec.

NIAGARA FALLS GENERATING PLANTS.

In a paper presented at the last convention of the American Institute of Electrical Engineers, Mr. H. W. Buck, consulting engineer for the Niagara Falls Power Company, gave a description of the generating plants now being installed at Niagara Falls and of the plant on the Canadian side of its allied company, the Canadian Niagara Power Company. The latter plant will be located in Queen Victoria Park, about 1,500 feet above the Horse-Shoe Falls, the intake canal, wheel-pit and discharge tunnel leading to the foot of the falls.

The unit in this plant will be of 7,500 kilowatts capacity, and the generators will be wound for 12,000 volts three-phase. The frequency will be retained at 25 cycles for the sake of uniformity with the American plants so as to permit of parallel operation. In selecting a unit of this large size, the American and Canadian systems were regarded as one. Since this is likely to reach ultimately an output of several thousand horse power, a unit of 10,000 h.p. is not a large proportion of the whole, and is not too large an amount of power to concentrate in one machine from the standpoint of convenience. The principal advantage in a unit of this size over the smaller one is, Mr. Buck points out, in the reduction in cost of development per horse power. This reduction in cost results from :

1. Lower cost of generator per horse power.
2. Lower cost of turbine per horse power.
3. A 10,000 horse power unit only occupies slightly more space than one of 5,000 h.p. capacity, which results, for a given plant output, in great reduction in length of wheel-pit, power house and fore-bay, and a consequent reduction in construction.

The generator is shown in assembly in Fig. 1. It is of the internal revolving field vertical shaft type, of General Electric manufacture. Its revolving field ring is built up of punched laminations, bolted together with joints lapped. This method of construction gives a uniform and definite strength of ring and high magnetic permeability. On account of the high speed, 250 r.p.m., the generator is very small as compared with some of the large engine-driven units, its over-all diameter being about 19 feet. The weight of the revolving part of the machine is 141,000 pounds, with a fly-wheel effect at 250 r.p.m. of 2,000,000,000.

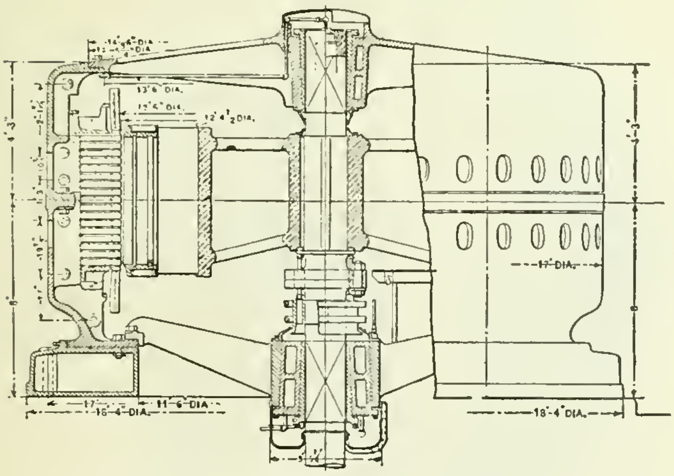


FIG. 1.—10,000 H. P. THREE PHASE GENERATOR, CANADIAN POWER HOUSE.

The generator has to be wound directly for 12,000 volts three-phase, instead of 2,300 volt two-phase, as in the American plants. This high voltage was selected, not for long distance transmission but for economy in distribution to power users near the power house. In distributing large amounts of power underground from a 2,300 volt two-phase plant, after a radius of about one mile is exceeded, it becomes cheaper to transform to 12,000 volts three-phase and distribute at this voltage than to supply power directly at 2,300 volts. From this it becomes evident that great economy results from the direct generation of the higher voltage. For long distance transmission step-up tranformers will be used to raise the voltage to 22,000, 40,000 or 60,000 volts.

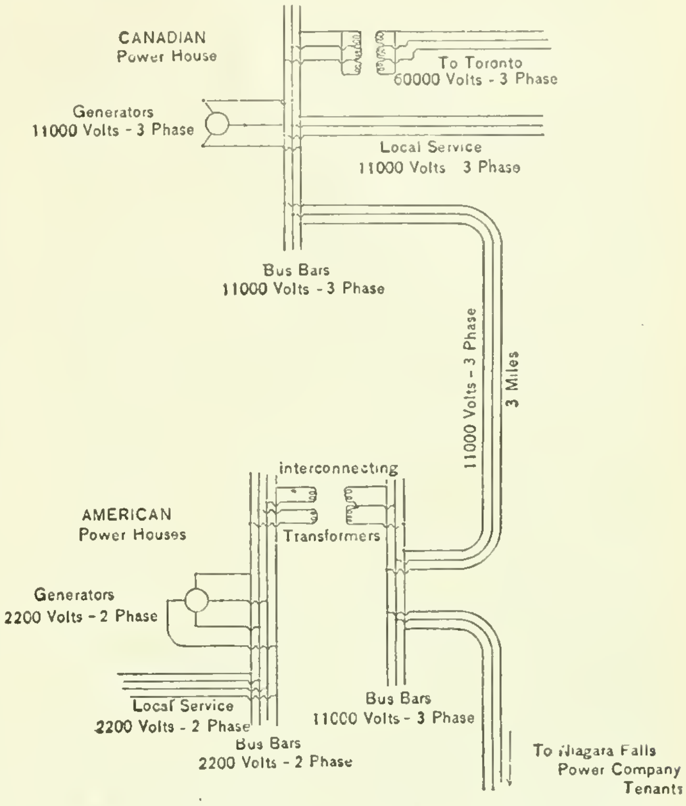


FIG. 2.—METHOD OF INTERCONNECTING CANADIAN AND AMERICAN POWER SYSTEMS.

Fig. 2 show the method which will be adopted for operating in parallel the American and Canadian systems. The connection will be made by triple conductor cables carried across the upper arch bridge over the Niagara Gorge. The paralleling will be done through step-down Scott connected transformers.

Satisfactory progress is being made on the power tunnel between Lake Beautiful and Coquitlam Lake for the Vancouver Power Company. Mr. W. Meredith is consulting engineer and Messrs. Ironside, Rannie & Campbell the contractors. A tramway for hauling supplies is also being constructed.

The St. Francis Power Company has been organized to develop a water power at Disraeli, on the Quebec and Central Railway, between Sherbrooke and Quebec. This power is situated near to Black Lake and Thetford Mines. It will be possible to develop about 2,000 h. p., which it is proposed to transmit electrically to power users in the locality. The Thetford Mines alone use about 2,000 h. p. and are said to be now operating very uneconomically by means of small steam engines, which are not only inefficient and uneconomical, but require a man to be in charge of each one. The company are also said to be paying about $4.50 a ton for coal, so that the cost per h. p. for 24 hours will probably amount to $100. By using electric power the company could probably reduce the cost by about one-half. Messrs. Ross & Holgate, consulting engineers, of Montreal, have been employed by the power company to prepare the plans for the utilization of the power. The company are said to have secured the ownership of all water powers within a radius of thirty miles from Disraeli.

ENGINEERING BUILDING QUEEN'S UNIVERSITY.

The Engineering Building now in course of erection at Queen's University, Kingston, will contain the central heating and electric plants and the departments of Civil, Electrical and Mechanical Engineering. Provision will also be made in this building, temporalily at least, for the Department of Forestry and Botany.

The boilers, which are to supply steam for heat and power to all of the various college buildings, will be located in a suitable wing connected to the east end of this building. The boilers will be of various types representing the best practice. The students will thus get a practical knowledge of the different types usually found in recently constructed plants. One boiler will be fitted specially for testing and experimental work, capable of carrying a pressure of 200 lbs. and supplied with a superheater. The draft will be obtained by two fans direct-connected to two separate engines and working in parallel.

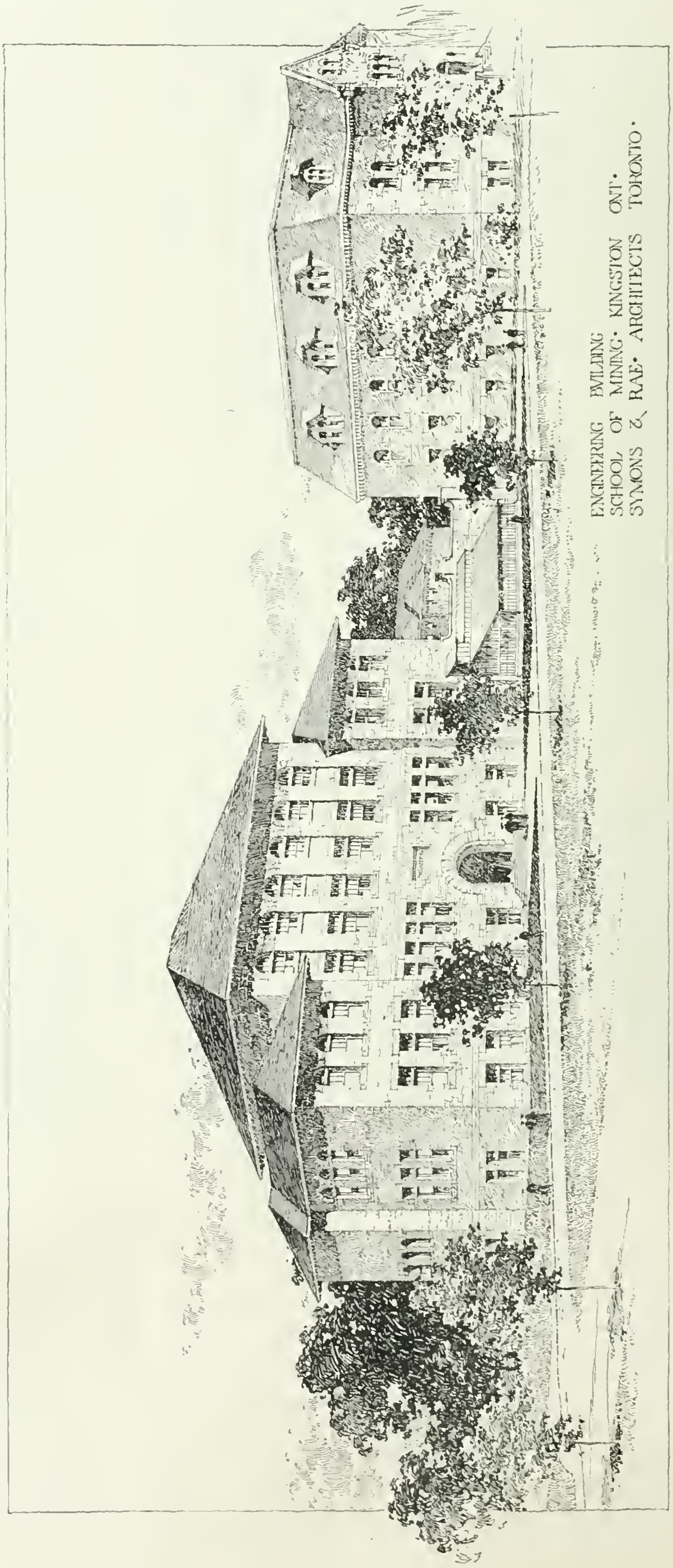
The electric plant will be placed on one side of the main building adjoining the boiler room. This plant will supply all the electricity required for light, power and experimental work.

Adjoining the electric plant on the south side of the basement are a storage battery room and three laboratories for experimental work in electrical engineering. The storage battery will be of sufficient capacity to light the college buildings in the evening when required, and when the electric plant will not be running. It will also be used very extensively for experimental purposes. The laboratories will be equipped with the most improved types of generators, motors, transformers, etc.

On the north side of the basement and adjoining the boiler room are two laboratories for experimental work in thermodynamics and mechanical engineering. These laboratories will be equipped with the latest types of steam and gas engines, compressed air, etc. There will also be a laboratory in the basement for measuring the strength and elasticity of materials.

The first floor will contain the various botanical laboratories, lecture rooms, library, cloak rooms and janitor's room. On the second floor will be the engineering lecture rooms, library and research room. The third floor will be devoted entirely to draughting, with the exception of two small rooms for blue-printing and photographic work.

A five year contract for the supply of electric power to operate the new pump at the high level waterworks reservoir in Montreal has been awarded to the Lachine Rapids Hydraulic & Land Company. The price is $20 per horse per year, making the cost for 400 h. p. for the period mentioned $40,000.


ENGINEERING BUILDING
SCHOOL OF MINING· KINGSTON ONT·
SYMONS & RAE· ARCHITECTS TORONTO·

QUESTIONS AND ANSWERS

"A. S.", Houston, Minn.: Would you please give answers to these questions in your October issue? (1) What would be the number of the wire you would use for the mains of an incandescent lamp circuit, carrying current for fifteen-hundred incandescent lamps, the voltage of each lamp being 110, and the candle power 16? (2) What would be the necessary capacity of the dynamo used to run the above circuit? (3) What would be the horse-power of a steam engine used to run the dynamo, when the dynamo is loaded to its full capacity?

Ans : (1) In the absence of advice as to the relative location of the lights and the distances between the various groups, also as to the character of the system, direct or alternating, two wire or three wire, single phase or multiphase, it is impossible to answer you intelligently, though we presume it is alternating three wire, in which case it will usually be found desirable to locate your transformers so that the largest wire required will not be over No. 4 or No. 6. (2) Assuming that you are using lamps consuming 60 watts each, the machine would need to deliver to the lamps 60x1500 = 90 k.w. Allowing for line losses, and also for those in the transformers if your system is alternating, the generator would need to have a capacity of 100 to 110 k.w., these figures being based on the supposition that all the lamps are burning at once; if this is not the case they can be reduced accordingly. (3) Assuming that the dynamo is delivering 100 k.w. to the line, and that the combined efficiences of it and the driving mechanism is 85 per cent., the engine would need to deliver $100 \text{x} \frac{100}{85} \text{x} \frac{1000}{746} = 157$, or say 160 horse power.

"Reader" asks: Does a three-phase generator wound for 10,000 volts mean that each phase used separately gives 10,000 volts, or does it mean 10,000 volts between each of the three wires on the three-phase transmission line?

Ans: If the windings of the generator are connected delta or mesh fashion, they are each designed to produce the rated potential of the machine, in your case 10,000 volts, and if they were used separately each as an independent single-phase system they would each give this pressure, but if the machine is designed with its windings connected star, the three windings each then produce only $\frac{1}{\sqrt{3}}$ or .577 times that of the terminal voltage of the generator, which would in this case be 5,770 volts. These connections you will note are in all cases made in the machine itself, and do not affect the outside line, which in either event has 10,000 volts between any two of the three wires composing it.

"J.B.": Is 50 cycle three-phase apparatus one of the standards or is it likely to become the standard for light and power work? Do 220 volt lamps flicker on a 50 cycle circuit?

Ans: Apparatus of this frequency is not standard on this continent, nor do present indications point towards its coming into more general use, though there are, of course, some plants installed here; it has been used quite frequently in European practice. 220 volt incandescent lamps are satisfactory on 60 cycle circuits, though they begin to exhibit flickering when run at a frequency of 40. We do not know of any 50 cycle plants which are using them, though it is probable that they would give satisfaction, except perhaps in situations where there was a fast moving object in front of the light.

"R. S.", Halifax : Can I use ammeters and wattmeters built for testing on 110 volts for 2,080 volt primaries?

Ans.—We see no objection to your using ammeters in this way, provided precautions are taken to insulate the case from the ground, as it is possible that the insulation in the instrument is not sufficient to withstand the tendency to ground, especially if there be any leaks in the primary line. The wattmeters can also be used in this way, a potential transformer being inserted in the voltage leads so as to bring the voltage across them within the limits of the instrument. The reading will naturally have to be multiplied by the ratio of this transformer.

"Dynamo" asks : Can I use an enclosed arc lamp, 6.6 amperes, for series circuits, on the same lines as open arc lamps?

Ans.—Yes, there is no objection whatever, provided the amperage is the same. You should note that the open lamp takes 50 x 6.6 = 330 watts, while the enclosed type consumes 80 x 6.6, or 528, which means that the change results in your furnishing lamps of a larger power consumption than was probably contracted for, or in other words, that the lamp capacity, though not the actual output of the machine, is reduced in that proportion.

W. H. Smith : What is the difference between the terminal and the receiver pressure of a steam engine?

Ans.—The terminal pressure is that in the cylinder at the expiration of the stroke, just before the opening of the exhaust valves. The receiver pressure, as the name indicates, is that in the receiver or chamber between the cylinders of compound engines.

"Subscriber" : How can I be sure that the connections of two machines are correct for running in parallell? What will happen if one starts to run as a motor?

Ans.—The simplest way to make absolutely certain that everything is in readiness for parallell operation is to raise the brushes or otherwise open the armature circuit only of one machine, and then to close all the switches, thus exciting its field from the other generator. If, now, the switches be opened and the second armature circuit closed both machines will come up with the correct polarity. If when they are running in parallel one field gets weak and that machine starts to run as a motor nothing special will happen, provided the field does not get too weak and thus too much current flow. If it does, the fuses or circuit breakers will operate, and save the equipment from actual damage.

"Power House Assistant" asks : What is the little curl of pipes found under nearly all steam guages put there for?

Ans.—It is used to retain water, condensed from the steam, which cannot get away because it cannot run over the uphill portion of the circle. Such a device should always be installed with every steam guage, as the entrapped water prevents the hot steam from reaching and damaging the instrument.

TELEGRAPH and TELEPHONE

THE BELL TELEPHONE COMPANY IN TORONTO.

In order to meet the requirements of their growing business in Toronto, the Bell Telephone Company have found it necessary to enlarge their Exchange on Temperance street. The addition, which is now under way, consists of a new building 45 by 80 feet, and in external appearance an exact duplicate of their present building. The upper flat of the new building is intended for operating purposes, and in it will be installed a new central energy switchboard. After the present subscribers have been transferred to the new board, the wall dividing the two buildings will be taken down and the present operating room used for the accommodation of the long distance switchboard and the future growth of the business. The new board will have a capacity of 8,000 subscribers, or nearly double that of the present board.

As the North Toronto and Parkdale branches are already equipped with central energy type switchboards, the inauguration of this system at the Temperance Street Exchange will place the entire city on an absolutely modern system, by which the ringing of the bell when calling Central will be done away with.

The second storey of the combined building will be devoted to the power plant and distributing departments, and the business offices, now on the second floor, will be removed to the ground floor. Increased accommodation will also be provided for the operating staff.

When the extension is completed, the Exchange will be sufficiently large to provide for the prospective growth of the company's business for some years to come, and in point of equipment it will be second to none.

RESIGNATION OF MR. ARTHUR COX.

Within the past month the announcement was made of the resignation of Mr. Arthur Cox, superintendent of supplies and treasurer of the Great North-Western Telegraph Company. For personal and private reasons Mr. Cox decided to sever his connection with the company, with which he had been connected for 27 years. It is his intention to return to England.

Mr. Cox came to Canada nearly thirty years ago, with the intention of following his profession as an artist, but finding the talent of the artist not appreciated in Canada as the calling deserved, he turned his attention to a commercial life. Obtaining a situation with the Great North-Western Telegraph Company, he was quickly promoted from one position to another, until finally receiving an appointment to the dual position of treasurer and superintendent of supplies. These are two of the most important positions in the gift of the company. The supply department, which has to cater for 2,000 offices, has been, under Mr. Cox's supervision, created into a model of methodical and precise management. The ability shown by him in the discharge of his duties was frequently commended by the management.

Mr. Cox is also an inventor of some note, one of the most valuable of his inventions being "Cox's Patent Infold", an ingenious device which, in one sheet, serves the double purpose of telegraph blank and envelope. This combination is used by all the Great North-Western Telegraph Company's offices.

The loss sustained in the removal of Mr. Cox is keenly felt by the company. In a personal letter to him Mr. H.P. Dwight, president and manager of the company, expressed his deep regret that he should have decided to retire from the company, at the same time referring to the satisfactory manner in which he had discharged his duties. At the annual meeting of the company held a fortnight ago a resolution was passed laudatory of the faithful services and abilities of Mr. Cox, who in his new field carries with him the hearty wishes of numerous friends in Toronto.

Mr. G. D. Perry, secretary and auditor of the company, succeeds Mr. Cox, having been appointed secretary-treasurer and superintendent of supplies.

OLD-TIME TELEGRAPHERS' ASSOCIATION.

The twenty-second re-union of the Old-Time Telegraphers' and Historical Association and the Society of the United States Military Corps was held at Salt Lake City, Utah, on September 10, 11 and 12. About 200 members were in attendance and a meeting of profit and pleasure was the result. The report of the secretary-treasurer showed a membership of one thousand, with a large list of applicants for membership. The age limit for admission was raised to 25 years. This action was deemed necessary in order to keep the membership down to a reasonable limit. Milwaukee was selected as the next meeting place, in September, 1903. The executive committee was enlarged and now stands as follows: L. B. McFarlane, Montreal; G. H. Corse, Ogden, N. Y.; H. C. Hope, St. Paul; H. J. Pettingill, Boston.

SHORT-CIRCUITS.

Hamilton Bros. have a telephone service between Singhampton and Glen Huron and the station at Smithdale. It is now proposed to extend the system to Collingwood.

The Nipissing Telephone Company, of Sturgeon Falls, Ont., has been incorporated, with a capital of $5,000. Messrs. C. W. Rantaul, jr., and A. J. Young are directors.

Mr. J. C. Shields, of Ashcroft, B. C., has secured from the Dominion Government the contract for the construction of the telegraph line between the 150-Mile House, Cariboo, and Quesnell Forks. The distance is about 70 miles.

Mr. Anselm Boyer, C, E., has been appointed superintendent of Government telegraph and cable lines in Quebec and the Maritime Provinces. Mr. Boyer was one of the engineers who laid out the route of the telegraph line to Dawson.

A company has been formed in Lafayette, Ind., to manufacture a pocket telephone. The receiver is shaped so that one hears and talks in it. An aluminum box is fastened to a telephone pole, a key fits this box, and, when inserted, calls the telephone exchange. It is claimed that the invention will be of great utility in cities for policemen in summoning help or sending fire alarms, and can be used on street car lines.

The Great Nothwestern Telegraph Company held its annual meeting in Toronto recently, at which directors and officials were elected as follows: H. P. Dwight, president and general manager; Adam Brown, vice-president; H. N. Baird, Col. R. C. Clowry, Richard Fuller, James Hedley, A. S. Irving, and W. C. Matthews, directors; Geo. D. Perry, secretary-treasurer and superintendent of supplies; A. C. McConnell, auditor.

After wrestling with the telephone question for some months, a special committee of the Ottawa city council has recommended that the council enter into an agreement with the Bell Telephone Company for the continuation of a telephone system. The ratepayers voted in favor of the establishment of a civic telephone system, but apparently the accomplishment of this was surrounded by too many obstacles to be undertaken by the council. The Bell Company will probably be asked to enter into a new agreement more favorable to subscribers than the old one. A rate of $40 per annum for business places and $25 for residences, with a reduction of $20 where three year contracts are entered into, is spoken of.

THE PREFERENTIAL TARIFF.

The news comes from Berlin that the German customs authorities will in future require certificates of origin in the case of American grain. This is regarded as a retaliatory slap at Canada for having granted preferential duty on British goods coming into this country. The Dominion should now demand a certificate of origin in the case of all imports from Great Britain. This would have the effect of shutting out large quantities of German goods which now find their way into Canada as British imports and get the benefit of the preference which was intended to apply only to British manufactures. The statement is made, on what appears to be good authority, that many German manufactured goods are shipped into England, where the assembling of the parts is done, after which the goods are exported to Canada and receive the benefit of the preference. At present there is nothing to prevent such a practice either by Germany or other countries. Means should be adopted to prevent the preference being accorded to any but bona fide British goods.

EXHIBITS AT TORONTO EXHIBITION.

In our notes in last issue on the display in the Machinery Hall at the Toronto Industrial Exhibition two exhibits were inadvertently overlooked. The most conspicuous exhibit, perhaps, was that of the Canada Foundry Company, which is controlled by the Canadian General Electric Company. Their display occupied a space extending along the entire side of the west end of the building. Behind snow white columns was an elaborate display of the products of the company, including waterworks supplies, combination and single drinking fountains, ornamental iron work, wrought iron fences, etc. An interesting feature was a freight car truck, one of an order of one hundred for the Canada Northern Railway; and another object of interest was a sample of the great forges, part of the equipment of the new forge shop of the Canada Foundry Company at Toronto Junction. There was shown an automatic cold pressed nut machine in operation, claimed to be the only one of its kind in Canada, and an automatic screw machine making 3x½ cap screws. At night the exhibit was brilliantly illuminated by the latest type of C. G. E. enclosed arc lamps.

The A. R. Williams Machinery Company had a good display of iron and wood working machinery, machinists' tools, etc.

AQUEDUCT THROUGH A MOUNTAIN.

The Vancouver Power Company, a corporation allied to the British Columbia Electric Railway Company, which owns all of the tramways in British Columbia, will soon undertake a novel piece of hydraulic engineering work in connection with an electric transmission project. A water power electric generating station is to be located near the headwaters of the Coquitlam River, and to add to the supply of water furnished by a dam it is proposed to tap a lake at an altitude of 2500 feet above the sea. Instead of laying a pipe line, the company will drive an inclined tunnel through a mountain of solid rock. The bore will be 3 by 8 feet, and 2½ miles in length. The cost of the tunnel is estimated at $350,000.

MONTREAL

The Gas Company have the same trouble to face now that electrical companies have had in the past, viz., "overloading of conductors". Owing to rapid installations of gas stoves, etc., partly helped by the coal strike, the pressure in certain localities is very poor.

Anent a fire which occurred in Montreal some months ago, caused by high tension entering the premises through a breakdown in transformer and owing to a faulty connection near main switch causing fire; we understand there is a probability of the insurance companies going to law over the matter, to hold the Lighting Company responsible. Without any comment on the points at issue, it does not seem fair that when the insurance companies are so decidedly indifferent to the appointing of an official inspector (owing chiefly to expense of such), that they should squeal when they get hit.

Poor Jack Roberts, whose body was found in the Lachine Canal recently, will be remembered by many of the old boys of the Royal Electric Company. He was one of their interior wiremen and a leading hand. After leaving their employ he acted for quite a time in a similar capacity with the Montreal Electric Company, and finally was employed by the Lachine Rapids Company on switchboard work, with whom he continued up to the date of his death.

Quite a number of contractors are of the opinion that a 9 hour day would be sufficient for their interior wiremen, and the chances are that if the wiremen put in such a request generally, it would be acceded to. Saturday afternoons, which are granted by some employers, could no doubt also be made universal.

A glance at the civic finances of Ottawa would suggest that in common prudence the municipal telephone exchange scheme should be shelved, at least for a while.

AMERICAN STREET RAILWAY ASSOCIATION.

As we go to press the twenty-first annual meeting of the American Street Railway Association is in progress at Detroit, Mich., the programme covering October 8, 9, and 10. Among the papers to be presented are the following: "Steam Turbine Engines," by E. H. Sniffen, New York; "The Adjustment of Damage Claims," by M. B. Starring; "The Transportation of Light Express and Parcel Delivery," by George W. Parker, Detroit United Railway. There is a large exhibition of street railway supplies.

THE PORTAGE LA PRAIRIE PLANT.

Portage la Prairie, Sept. 20th, 1902.

Editor Electrical News:

Dear Sir:—I notice in your September number exception is taken to the description of the Portage Electric Company's plant. I would say in reply that the description applies to the plant as it is at the present time, and not as it was ten years ago.

Yours truly,

F. W. Clayton, Manager.

The Browning Engineering Company, of Cleveland, Ohio, has recently purchased from the Westinghouse Electric & Manufacturing Company a large number of railway-type crane motors, ranging in capacity from 25 to 50 horse-power.

The cross arms on the redwood poles commonly used for the electric transmission lines of the Pacific Slope are of 6x6-inch kiln dried Oregon pine, subjected to a temperature of 220 degrees Fahr. for several hours in a bath of asphaltum oil. The redwood poles are cut from young trees, not more than four from the one tree, and are counted on to last 25 to 35 years.

The Steel Storage & Elevator Construction Company has adopted electric power distribution for a large grain elevator which will be erected for the Canadian Pacific Railway at Fort William, Ontario. A recent purchase from the Westinghouse Electric & Manufacturing Company includes a direct current generator and a number of direct current motors for the operation of this elevator.

ASSESSMENT OF GAS AND ELECTRICAL COMPANIES.

Judges McDougall, McCrimmon and McGibbon gave judgment on October 4th in the appeal of the Toronto Railway Company, Consumers' Gas Company, Bell Telephone Company, Toronto Electric Light Company, and Toronto Incandescent Light Company against their assessments by the city officials. The judgment is against the companies.

The contention of the companies concerned was that under the clause in the Assessment Act of 1902 exempting rolling stock, the machinery and appliances in their buildings were not assessable. They claimed that the exemption applied to the rolling stock and all their plant and appliances save those existing on or situate upon the streets, roads, highways, lanes, and other public places of the municipality. The judgment hinged on the interpretation of sub-section 4, which reads "Save as aforesaid rolling stock, plant and appliances of companies mentioned in sub-section 2 hereof, shall not be land within the meaning of the Assessment Act and shall not be assessable." The judges point out that the construction which the companies desire to have placed on sub-section 4 would be unjust and inequitable, and contrary to the principles underlying the Assessment Act. The judgment concludes as follows:

"The conclusion of the matter then is, that the words 'plant and appliances' used in sub-section 4 must be confined to any plant and appliances located upon the streets, roadways and highways and other public places in the municipality, such words taking this limited meaning because they must be referred to the words 'rolling stock' which immediately precede them in the same sub-section, and because it was manifestly the intention of the Legislature in enacting a new section 18 of the Assessment Act, to deal only with the method of assessing so much of the property of the companies named in sub-section 2 as was situated upon the public streets of the municipality.

"This is the unanimous finding of the Board of Judges upon the construction of the Statute of 1902, but is not the formal judgment to be delivered upon the appeals pending. The formal judgment will be pronounced after hearing the evidence upon the appeals when the figures of the assessment of the property involved in the different appeals will be determined. The opinion of the judges upon the construction of the statute is issued in advance at the request of the parties."

PERSONALS.

It is understood that Mr. Alex. Storer has received the appointment of chief engineer for the King Edward Hotel, Toronto, at a salary of $1,200 per year.

T. W. Rawling, of Annapolis, N. S., has resigned his position with the Cape Breton Electric Co. to take a responsible position with the South Shore Railway Co.

Mr. R. H. Henecker has resigned as president and director of the Sherbrooke Gas & Water Company, of Sherbrooke, Que., and has been succeeded by Judge White.

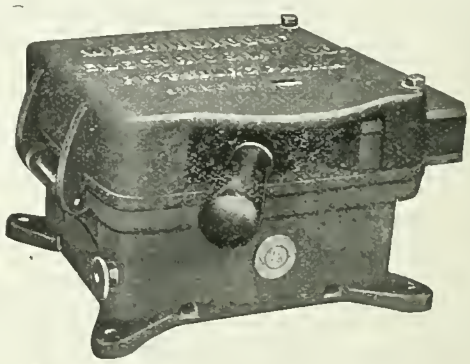
Mr. Clarence Thomson has resigned the position which he has held for some years in the Patent Department at Ottawa, to join his father, Mr. Fred Thomson, in the electrical manufacturing business in Montreal.

Sylvester Potter, chief electrician for the Toronto Railway Company, a fortnight ago tendered his resignation, which was accepted by the company. Mr. Ewen Mackenzie, a brother of the president of the company, is now in charge of the department, but it is understood that the appointment is only temporary until a suitable person can be found to succeed Mr. Potter.

AUTOMATIC CAR-TYPE CIRCUIT-BREAKER.

The protection of railway motor equipments by the use of a fuse has until recently been the standard practice and recommendation of electrical manufacturing companies. The results obtained have been satisfactory only to a limited degree, as the fuse frequently fails to blow at the proper time, or to give the equipment the best protection under all conditions of service. The necessity of carrying extra fuses, as well as the inconvenience of stopping the car to replace a blown out fuse, is more or less of an objection to this method, and many of the largest street railway companies have replaced the fuse block with the automatic car circuit-breaker. This practice offers better protection to the equipment, as it reduces to a minimum the possibility of injury to the apparatus arising from the carelessness of the motorman in improperly cutting out resistance—the circuit-breaker will open automatically when the current reaches the value for which it is set.

The automatic car circuit-breaker manufactured by the Westinghouse Electric & Manufacturing Company is claimed to perform the function of the fuse block by opening an overload or short-circuit; it also replaces the platform or canopy switch, in that it provides a hand opening for the circuit. In construction the instrument is thoroughly fire-proof, of the best material and workmanship throughout, and all parts are interchangeable. Its design prevents any arcing at the current-carrying contacts, as the arc is broken on extra contacts especially provided for the purpose, and assisted by a powerful magnetic blow-out which will open the severest short-circuit without damage. The breaker is calibrated, and can be set to open at any current within the limit of its range. The automatic opening device is said to insure absolute certainty in opening when the current reaches the predetermined value—a feature not found in any latch device, particularly if it is exposed to such weather conditions as are found in the vestibule of a street car.



Automatic Car-Type Circuit-Breaker.

NEW INDUCTION MOTOR METER.

A patent has been granted to Mr. G. L. Gowland, of Peterborough, Ont., for an induction motor meter. One object is to provide a meter having a large range and provided with a rotating armature that shall run at a speed exactly proportionate to the amount of current passing through the meter. Another object is to provide a meter which will work equally well with either inductive or non-inductive loads. This meter, Mr. Gowland remarks, should not be confounded with any meter having the usual so-called "90-degree lag," or any similar phenomena. It differs from such a meter in this respect, namely, that the flux produced at the poles of the magnets on the so-called "voltage" side of the meter is a stationary flux and is not of a revoluble nature. He obtains the rotation of the disk partly by using a so-called "voltage-magnet," the core of which is split into two members and a flat bar of copper inserted there-between. Mr. Gowland states that he has found that a flux-plate composed of thin sheets of laminae or copper disposed in planes parallel with each other and also parallel with the plate when excited by a magnet in immediate proximity to said plate produces a considerable rotative effect. The effect appears to be governed largely by the amperage rather than by the voltage of the current. With a meter of the type described, the aluminium disk need not be placed so near the magnet-poles as is required in most other meters. This fact presents the considerable practical advantage that particles of dust or dirt accumulating upon the plate do not interfere with its action, and any slight distortion of the disk is less objectionable than is the case with ordinary meters.

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ELECTRIC TRACTION IN SOUTH AFRICA.

During the progress of the Boer war there was constructed the Camps Bay, Cape Town and Sea Point Tramway, an electric road of nine miles in length extending from Round Church to Burnside Road, in South Africa. The work was executed by Messrs. Dick, Kerr & Company, Limited, of London, England, who have recently established a branch in Canada. In addition to the difficulties encountered under ordinary circumstances, the course of the war prevented easy shipping facilities and an adequate supply of labor, yet in spite of these drawbacks the system was completed without any serious delay. Through the kindness of the Canadian branch of Messrs. Dick, Kerr & Company, we are permitted to show several interesting illustrations pertaining to the road.

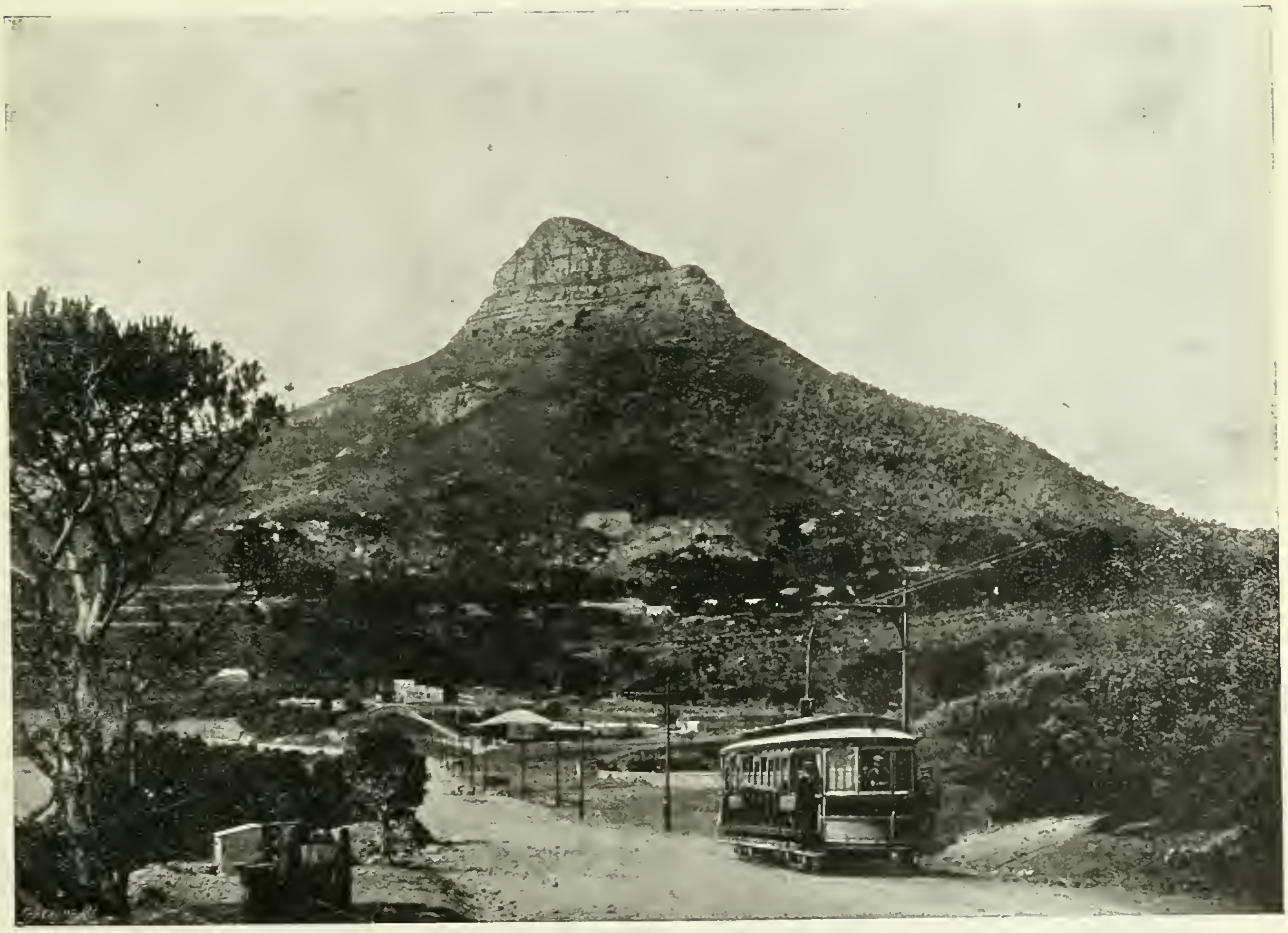


Fig. 1. -View on Camps Bay, Cape Town and Sea Point Electric Railway, South Africa.

As might be expected, steep grades are encountered, a diagram of which is shown in Fig. 2. Beginning at Round Church, Sea Point, on the south-west of Cape Town, the line commences on an easy ascent, but though gradual, it has reached at the end of the first mile an altitude of nearly 300 feet, and grades of 1 in 12 or 8·33 per cent. Continuing southward Upper Clifton is reached, and at this point a magnificent view is obtained of Camps Bay. About a mile distant and near the centre of the line stands the power house. The most southerly point of the tramway is reached at Oudekraal. Here the line diverges in a north-easterly direction, and, after encountering the heaviest grades of the system, the highest altitude is reached at Kloof Nek. At this point, some 800 feet above sea level, there is obtained one of the finest views in the Colony. As affording some indication of the difficulties of construction, it may be observed that the average grade from Kloof Nek to the terminus at Burnside Road, a distance of little more than 1¼ miles, is slightly steeper than 1 in 12. Severe though this may be, it is exceeded in other places, where grades of 1 in 9 are encountered for short distances.

Besides making provision for carrying off the heavy rains by means of capacious drains and culverts, massive retaining walls had to be constructed, consisting of dry stonework laid in courses. In places these were of exceptional strength, measuring from 6 to 10 feet thick at the base, and from 20 to 25 feet in height, crossing the deep sluits or water-courses on the estate.

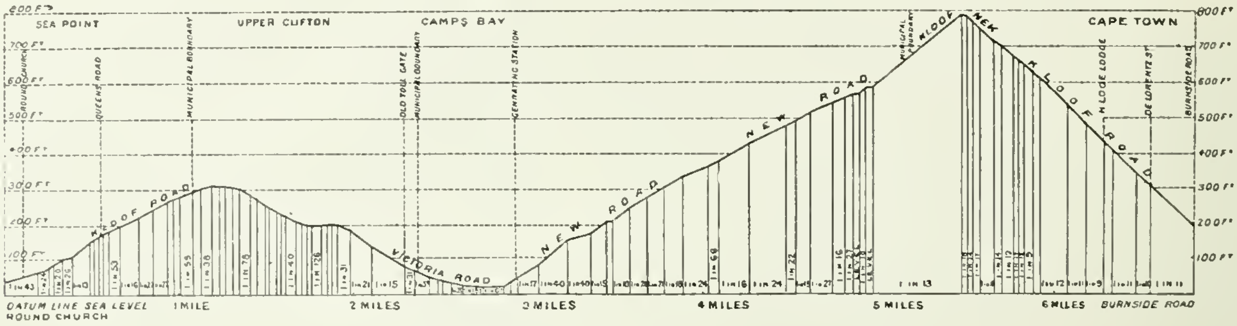


FIG. 2.—DIAGRAM OF GRADIENTS, CAMPS BAY RAILWAY.

PERMANENT WAY.

The gauge of the tramway is 4 feet 8½ inches, and is thus uniform with the Cape Town tramway, over which system running powers have been obtained. The rails are of girder section, weighing 90 lbs. to the yard. They are laid on a concrete foundation, a strip of concrete 6 inches deep and 18 inches wide, composed of 5-1 Portland cement, being laid under each rail. Karri wood paving has been laid for a width of 1 foot 10 inches on each side of the track, and a 9-inch toothing course along the inner side of each rail. The rail joints are each bonded with two 6/0 S. W. G. "Neptune" rail bonds. Special cast steel points 8 feet 8 inches long, and 1 in 9 crossings, have been used.

OVERHEAD EQUIPMENT.

The side-wire system has been adopted, the trolley wire (No. "O" B.W.G.) being carried at a height of 18 feet 6 inches above the rail level. The poles are of mild steel, tapering from 7 inches at the base to 3½ inches at the top, and are furnished with ornamental base castings, finials, and brackets. The arms vary in length from 6 feet 6 inches to 15 feet according to the width of the road, the average distance of the farthest trolley wire from the centre of the track being 10 feet. Owing to the tortuous character of the route it has been found necessary to run the trolley wire partly on one side of the road and partly on the other to allow of the poles being fixed in the most suitable positions. As many of the curves are of very sharp radii, it will readily be understood that the wiring of these required con-

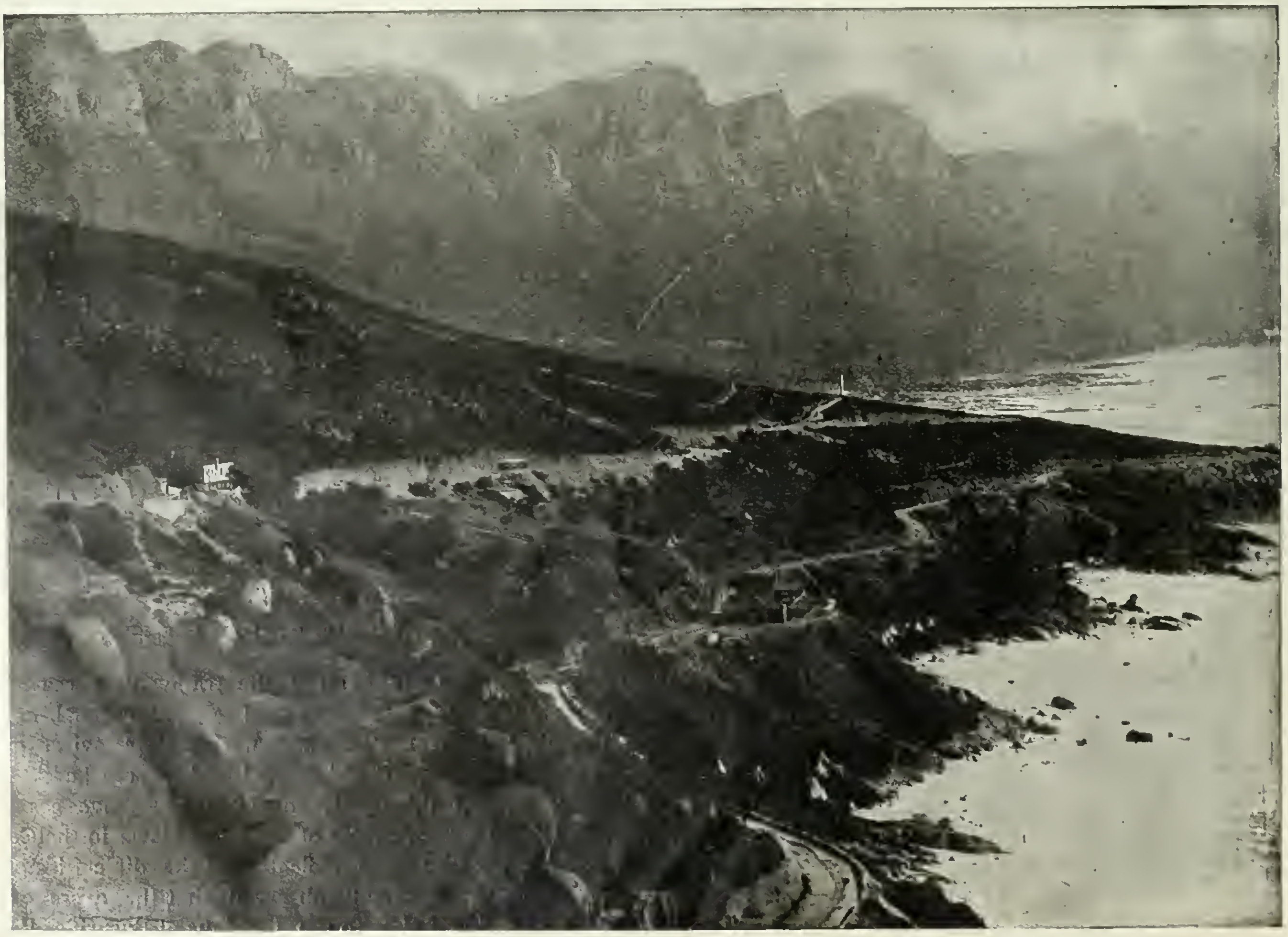


FIG 3.—GENERAL VIEW (CHIMNEY OF POWER STATION VISIBLE IN THE DISTANCE.)

siderable care to avoid the use of a large number of poles and the angles of the trolley wire being too acute. As will be seen from the diagram map, it is probably one of the most tortuous and heavily-graded roads equipped on the overhead system.

GENERATING STATION.

The generating station and car shed is situate near Camps Bay, almost at the southern extremity of the system. This site was the most suitable owing to its proximity to the sea, from whence water is drawn for condensing purposes. Another reason lay in the fact that a continuous supply of fresh water for boiler feed purposes is obtainable from a spring, a small stream flowing therefrom down Table Mountain.

The engine room (Fig. 4) is 94 feet by 42 feet, and consists of two floors and a condenser pit. An overhead travelling crane, arranged for hand power and capable of lifting 10 tons, runs the whole length of the engine room, and has a lift of 16 feet. The boiler house is 94 feet long by 43 feet 5 inches wide. The car shed, which is also part of the same buildings, is 136 feet long by 94 feet wide, with 8 lines of track, 4 of which have pits running their entire length.

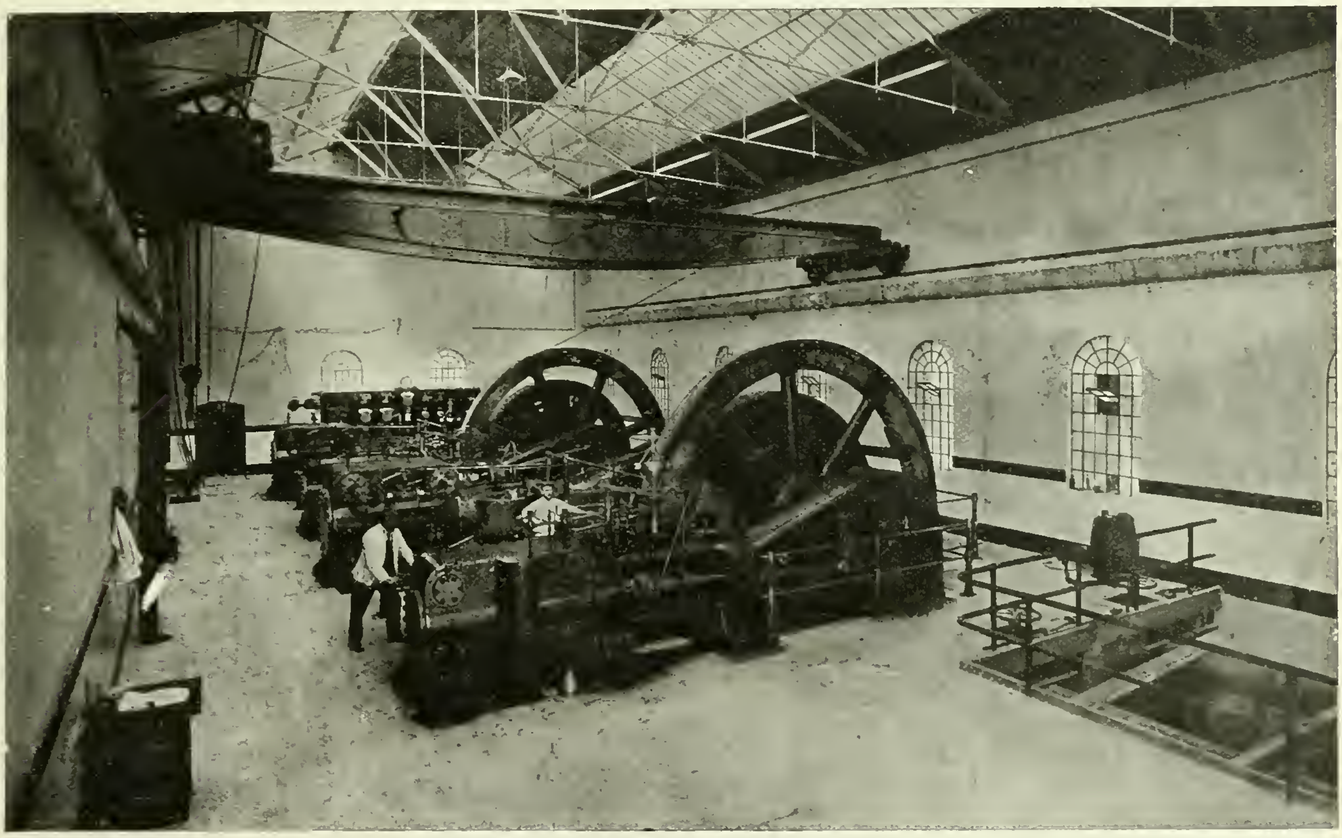


Fig. 4.—Interior of Engine Room.

The generating plant consists of two direct-coupled 400 kilowatt sets. The engines, constructed by Messrs. Yates & Thom, are of the cross-compound type, developing 720 brake horse-power with a steam pressure of 150 lbs. at the cylinders when running at 90 revolutions per minute. The main shafts are 19 inches diameter, and on these the generators and fly-wheels are keyed. The latter are 18 inches diameter and weigh about 24 tons. The cylinders are fitted with Corliss automatic valve gear.

The generators were built at the works of the English Electric Manufacturing Company, Ltd., Preston England (since aborbed by Dick, Kerr & Company), and were subjected to severe tests by the engineers of the company, who were highly satisfied with the way in which their specification had been met. The output of the machines is 400 kilowatts at 550 volts. The chief features of these generators comprise the use of a high-permeability cast-iron magnet frame, into which are cast laminated steel pole-pieces. The armature is built up on a special form of spider, in which the sections of the rim are unconnected, thus avoiding shrinkage strains. The core is built up of steel laminations, spacing laminations being inserted to form ventilating ducts for cooling the interior of the core and the windings. The armature coils are laid in open slots on the periphery and are interchangeable. The commutator is carried on its own ring, which is mounted on an extended limb of the armature spider. The commutator bars are of hard-drawn copper, and are firmly clamped by means of steel end rings. Equalizing rings are attached to the commutator and equalize any slight variations in the magnetic reluctance of the various magnetic circuits, thus checking the slightest tendency to spark.

The switchboard, shown in Fig. 5, consists of nine panels, of which three are generator panels, three feeder panels, one station panel, one lighting panel, and one leakage panel. Two of the generator panels only are in use, the other being a spare panel. Each is fitted with a positive and negative quick-breaking switch capable of carrying 1,000 amperes, a magnetic circuit breaker, and an ammeter reading from zero to 1,200 amperes. Two of the feeder panels are in use, the other being a spare. Each is fitted with an automatic circuit of the same type as those used on the generator panels, an ammeter reading up to 500 amperes, and a quick-break switch for connecting feeder to busbar.

The main station panel is fitted with a main ammeter reading up to 3,000 amperes, on which the total output of the station is constantly shown, and a recording wattmeter. It is also fitted with a recording voltmeter with a working pressure of 550 volts. The leakage panel contains all the instruments necessary for testing for leakage, etc. The lighting panel is arranged for six 50-ampere double-pole circuit switches with fuses and throw-over switches.

In the condenser pit are two surface condensers with combined air and circulating pumps. These are of the Admiralty type, and are specially devised for using sea water. The sea water is supplied to the condensers by means of large cast-iron pipes, which are carried well out beyond low-water mark. To avoid the danger of seaweed being drawn up into the condensers, the suction pipe has been intercepted on the shore by a sump built in concrete carried well down below low water level, which is easily kept clear.

In the boiler house are two water-tube boilers, each with a heating surface of 3,654 square feet and capable of evaporating 12,000 lbs. of water per hour under normal conditions. Each boiler is fitted with a deadweight safety valve and a spring valve set to blow off at 160 lbs. pressure. The collars are fed by means of two compound non-condensing duplex feed pumps working at a pressure of 160 lbs., and capable of delivering 24,000 lbs. of water per hour against a boiler pressure of 160 lbs. Before being pumped into the boilers the feed water is passed through a fuel economizer containing 288 pipes fixed in the main flue. The chimney stack is 125 feet in height and 5 feet inside diameter at the top.

ROLLING STOCK.

Owing to climatic conditions, a variety of cars was found necessary. The cars are single-deck bogie type; part are what are known as gridiron open cars and part are of the combined type. The former have a seating capacity of sixty-five passengers, and the latter of fifty-four. The length of the car is 40 feet, width 7 feet 6 inches, and height inside 8 feet. They were built for Messrs. Dick, Kerr & Company, Limited, by the Electric Tramway Carriage Works, Preston, and shipped to Cape Town completely finished, the only work to be done before they could commence to run being to mount them on the trucks, connect the wiring and fix the trolley poles. Departing somewhat from the usual lines, the equipment of the cars comprises four motors each, of 25 brake horse-power, so that each car is capable of developing 100 brake horse-power. There is hardly any question that four motor equipments with long cars are imperative where grades are heavy, and in the case of Camps Bay the gradients are unusually severe. Not only, however, is a proper distribution of power necessary, but the question of braking and retardation is of prime importance. The brakes, therefore, on these cars have received very careful consideration, three brakes having been fitted, viz., a hand brake with a brake block on each of the eight bogie wheels, an air brake acting in conjunction with the hand brake, and an auxiliary slipper brake. In addition to these it is also possible, by throwing over the reversing switch, to convert the motors into generators, thus enabling them to act as a powerful emergency brake. The cars are operated from either end, by means of special controller, designed for four-motor equipments.

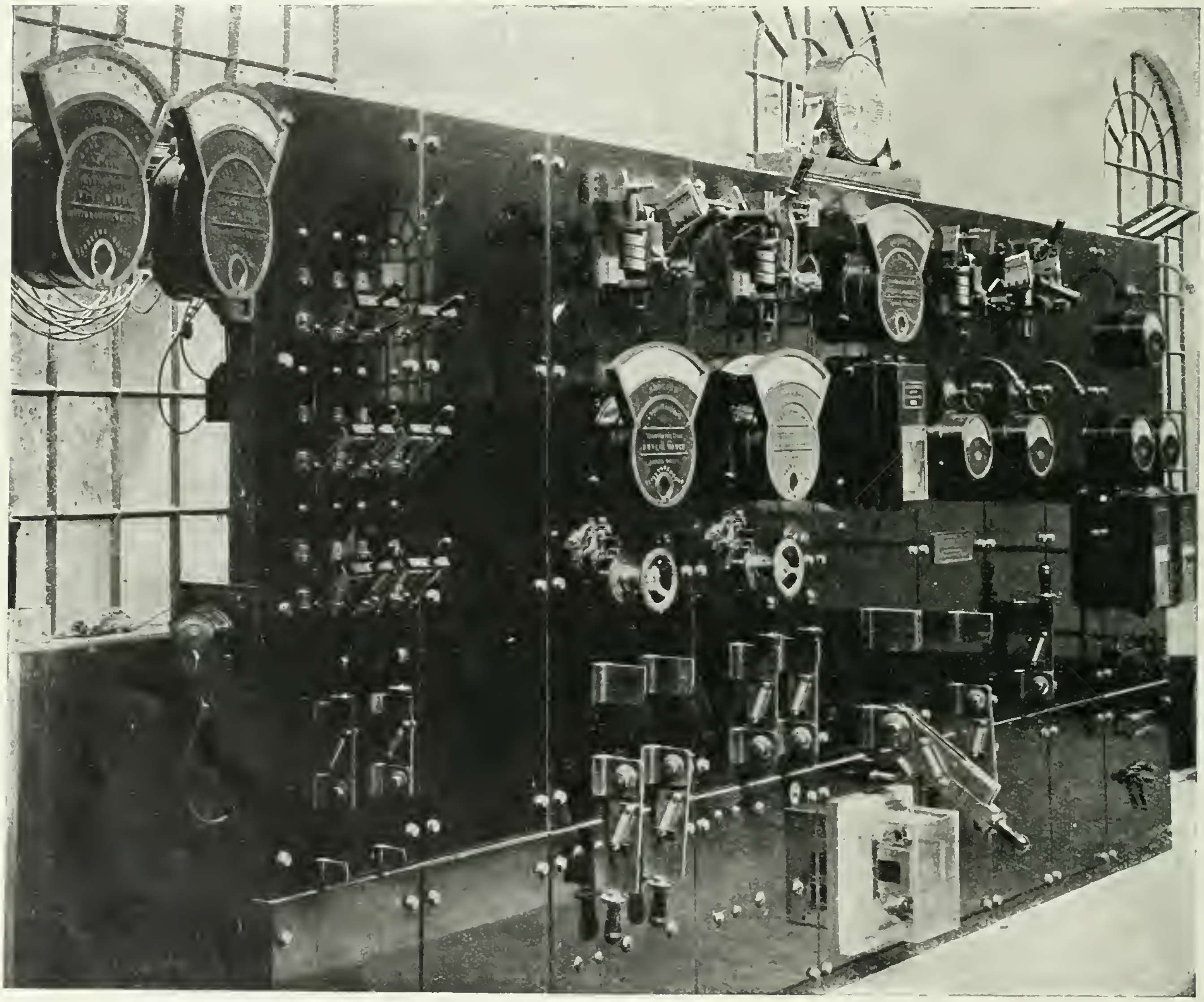
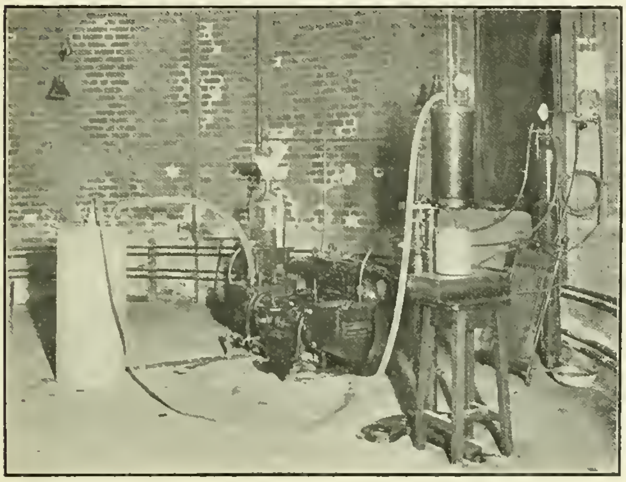


Fig. 5.—Switchboard.

THE HAMPSON LIQUID AIR PLANT AT McGILL UNIVERSITY, MONTREAL.

By Prof. John Cox.

The requisite conditions for liquefying gases have been well understood since the classical researches of Andrews on carbon dioxide in 1862. For every gas there is a "critical" temperature. Above this it cannot be liquefied by any pressure. Below it sufficient pressure will liquefy it. Hence the failure of the older experimentees who relied on pressure alone.



Hampson Liquid Air Plant, McGill University.

A gas can be cooled in two ways. It may be allowed to expand, doing external work at the expense of its energy and falling in temperature. Or it may be boiled off from the liquid under low pressure, when the necessary latent heat of vaporization is abstracted from surrounding objects, intensely cooling them. Cailletet used the former process. The gas to be liquefied was enclosed in a small tube sealed with mercury and inverted mouth downwards in a strong iron cylinder. Water was pumped into the cylinder, driving the mercury up the tube. The pressure was finally raised to 300 or 400 atmospheres by forcing a piston into the cylinder by a powerful screw. A valve was then opened, the gas was cooled by the sudden expansion below its critical point, and liquefied under the great pressure. A mist of liquid particles appeared for an instant in the tube, but no quantity of liquid was produced.

Pictet placed the gas under powerful pressure, and cooled it by allowing a more easily liquefied gas, such as carbon dioxide, or sulphur dioxide, to circulate around it in a jacket. The carbon dioxide was boiled off at low pressure, causing intense cold. The same pump then compressed it again and returned it to the jacket. By employing several stages, using each gas to cool a more refractory one, Pictet liquefied oxygen in quantity.

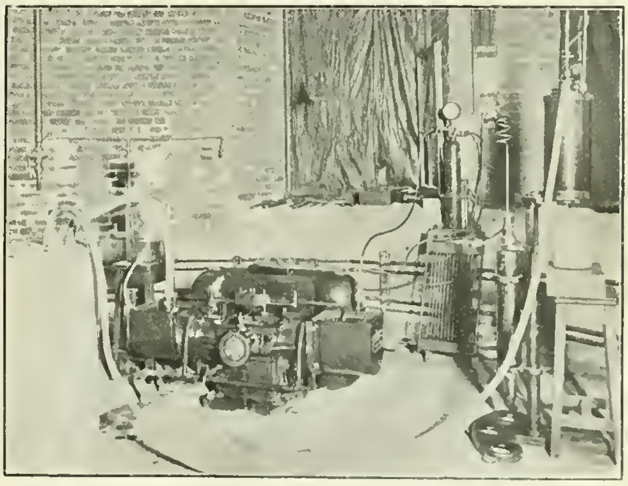
Essentially the same plan was followed by Dewar in his early experiments. But by using liquid ethylene and very powerful pumping apparatus, he obtained much larger quantities of liquid air.

In the Hampson apparatus, as in the somewhat similar machine devised by Linde, no cooling liquids are used. The process is regenerative. Air at 200 atmospheres pressure is allowed to escape at a small aperture, and is cooled on expansion. This cooled air is led back along the outside of the copper tubes through which the air is advancing to the expansion valve. The next lot of air is thus cooled before escaping, and drops to a still lower temperature on expansion. In its turn it cools the next portion of air, and when the process has gone on steadily from 6 to 10 minutes the temperature is found to have fallen below the critical point for oxygen—119 C. After this a portion of the escaping air is liquefied and collected in a vessel placed below the expansion valve, whence it may be drawn off at intervals.

The Hampson apparatus recently presented to McGill University by Sir W. C. Macdonald consists essentially of a compressor capable of supplying a stream of air at 200 atmospheres pressure, or 3,000 lbs. on the square inch, and the liquefier, seen on the extreme right of the picture.

The compressor is of the type used on torpedo boats for charging the compressed air chambers of the torpedos. It is made by the Whitehead Torpedo Company of Fiume, and is an admirable piece of designing. The compression is effected in two stages. The two pumps are placed back to back and connected to the same crank. They have a 3-inch stroke, and are driven at 375 revolutions per minute by an 11 h.p electromotor of the Manchester type, direct-coupled on the same base. The low pressure cylinder (on the left) has a diameter of 4⅞″, the high pressure (on the right) 1 5-16″. The air is raised to 16 atmospheres in the low pressure cylinder, and passing over by the copper tube to the high pressure cylinder is there raised to 200 atmospheres. The thrust on the high pressure piston-rod at the end of the stroke is about 2½ tons, yet the balance is so perfect that when the compressor is running at 375 revolutions the water in the cooling tanks at the ends hardly shows a tremor. The length of the compressor is 4 ft. 6 in. over all.

The piston cups are lubricated with water taken in at a drip-cock on the suction trunk. To get rid of the water the air is next passed into a separator (set up on the back wall). The water drops to the bottom and is blown off at intervals through a valve. The dry air passes out at the top to the bottom of the high pressure purifier—the black vertical cylinder attached to the lower part of the stand on the right. This is packed with lumps of caustic potash to remove the water vapor and the carbonic acid, which would otherwise solidify and block the pipes of the liquifier. The liquefier is the cylinder about 18 inches high seen on top of the stand. The air, now pure and dry, passes



Hampson Liquid Air Plant, McGill University.

through four sets of copper coils, interlaced, two in each direction around the axis, down to the expansion valve, regulated by the milled head at the top, and returns through the spaces between the coils to the outlet. Thence by the rubber hose it passes into the low pressure purifier. This is the galvanized iron cylinder on the left, which contains trays packed with partially slaked lime. From this it returns to the compressor together with a supplementary supply of air drawn in through a free nozzle on the low pressure purifier. The object of the latter is to save the charge of caustic potash in the high pressure purifier, and avoid the necessity of opening it too frequently.

On top of the liquefier will be seen two gauges. One of these gives the pressure of the escaping air at the outlet, so that the rate of expansion may be controlled. The other is connected to the bottom of the receiver in which the liquid air accumulates beneath the expasnion valve, while the gauge tube is connected through the hollow axis of the valve regulator with the space above the liquid air. The depth of air in the receiver is thus known. It is drawn off by the discharge valve at the bottom of the receiver into a Dewar vacuum vessel so soon as 100 c. c. have accumulated, i. e., about every 6 minutes.

The apparatus is remarkably simple and efficient. Two thermometers give the temperature of the air at entrance and exit, and so perfect is the interchange of heat, that when the temperature at the expansion valve is—180°C, the thermometers only differ by about one degree, reading 19°C and 20°C for example during one of the runs.

The apparatus was ready for trial and connections were finally made at 5:10 p.m. on Tuesday, October 21. The pressure was run up to 160 atmospheres, when the expansion valve was slightly opened. By 5:20 the gauge indicated the formation of liquid air; by 5.40 p.m. about 100 c. c. had been drawn off, and both mercury and alcohol frozen solid in it. Since then runs of three and four hours have been taken almost daily to supply liquid air for researches now in progress on the radia-active emanations from radium and thorium. Both of these were condensed at the first attempt on Wednesday, October 22nd. The rate of production is about one litre per hour, and liquid air can be obtained at any time within a quarter of an hour of starting the motor, allowing for a preliminary blow through of six or seven minutes to dry the tubes.

ELECTRIC HEATING.

The eleventh census of the United States shows that electric heating and cooking has become of practical service. Sales of electric heating and cooking apparatus, and of rheostats, amounted in 1900 to over $1,186,000. For 1901 these figures can probably be increased by twenty per cent. with a fair approximation of the truth. This is certainly a respectable showing and indicates a well established industry. Further, it is stated upon good authority that there are now in use in the United States 5,000 chafing dishes, 50,000 heating irons and 150,000 car heaters. A single hat factory in New Jersey is at present using 250 horse power for electric heating apparatus alone.

The ratepayers of Greenwood, B. C., will vote on a by-law to raise money to construct the Greenwood-Phoenix tramway.

THE AMERICAN STREET RAILWAY ASSOCIATION.

The twenty-first annual meeting of the American Street Railway Association was held in Detroit on October 8, 9 and 10. From every point of view it was very successful ; the total number of persons registering was 1,779. The Association has grown to such a size and the need of a large exhibit hall has become so imperative that there are but few cities in the United States which are suitable meeting places. For this reason the committee appointed to select a meeting place for the convention of 1903 was unable to report a decision.

A lengthy address was delivered by President Vreeland, in which he pointed out that eleven years ago there were only 1,800 miles of electric road in the United States, while to-day there are upwards of 24,000 miles, representing an investment, approximately, of $2,000,000,000. He referred to the prospect that the direct application of alternating current to railway work would remove some of the inconveniences which now exist in the present system. G. W. Parker, of the Detroit United Railway, read an interesting paper on "The Transportation of Light Express and Parcel Delivery." He explained in succession the various details of the express system organized by the Detroit United Company.

Perhaps the most interesting paper of the convention was presented by E. H. Sniffin, entitled "The Steam Turbine ; its Commercial Aspect." Mr. Sniffin gave information in detail of turbine plants now in operation. In units as small as 400 k. w., a result may be obtained of 14.47 pounds of steam per brake horse power per hour, corresponding to 13¾ pounds per indicated horse power. In a recent instance a result of 11.7 pounds of steam per electrical horse-power per hour was guaranteed on a turbine of 750 k. w. capacity, corresponding to about 10.17 pounds per indicated horse power, which is perhaps within the ability of but few engines of any size or type that have ever been built. The space required for the steam turbine was a consideration in its favor. The quantity of foundation material required also made a favorable comparison. The only foundation needed for the turbine is that necessary to hold its weight. In a showing of the comparative engine-room building cost, the basis assumed was fifteen cents per cubic foot of space inside of walls. The building cost of the turbine is about one-half of what is required for the horizontal or vertical engine. As to the cost of the turbo-generator itself, Mr. Sniffin stated that its price is reasonable; indeed, where the comparison is fair the turbine will require the lesser first investment. The larger field for the turbine begins about where the high speed engine leaves off. The advantages of the turbine in parallel operation were brought out, and also in the use of superheated steam. The turbine may be used unreservedly with superheat of any feasible temperature.

A number of other papers bearing directly upon electric railway work were submitted. J. C. Hutchins, president Detroit United Railway, Detroit, was elected president; W. Caryl Ely, president International Railway Company, Buffalo, first vice-president; W. Kelsey Schoeff, president Cincinnati Traction Company, second vice-president; P.S. Arkwright, president Georgia Railway & Light Company, Atlanta, third vice-president; T. C. Pennington, treasurer Chicago City Railway, secretary and treasurer.

The exhibit of electrical aparatus at the convention was most complete and attractive, embracing practically everything within the realm of street railway operation.

Canadian companies were represented at the convention by the following : E. H. Heating, M. Power, D. Sutherland, G. H. Sweetlove, W. H. Moore, W. H. Nix, R.E. Brown, D.J. Kearns, H. Cowan, Toronto Street Railway Company; E.D. McCormack, A. B. Lambe, Canadian General Electric Co., Toronto; E. B. Biggar, A. W. Smith, B. B. Jenkins, Toronto; T. W. Casey, W. G. Ross, D. Robertson, Montreal Street Railway Company; W. Phillips, Winnipeg Street Railway Company, Winnipeg, Man.; William Pulling, Windsor, Sandwich & Amherstburg Railway, Windsor, Ont.; T. Ahearn and Warren Y. Soper, Ottawa Electric Railway Company; C.K. Green, T.B. Griffith, D. N. Miller, Hamilton Electric Light & Cataract Power Company, Hamilton; C. E. A. Carr, H. Break, R. H. Welbern, E. R. Carrington, London Street Railway Company.

The City Council of Toronto have accepted the tender of the Canadian General Electric Company for electric generator for city hall, and that of the Waterous Company, Brantford, for engine.

SCHOOL OF PRACTICAL SCIENCE: CHEMISTRY AND MINING BUILDING.

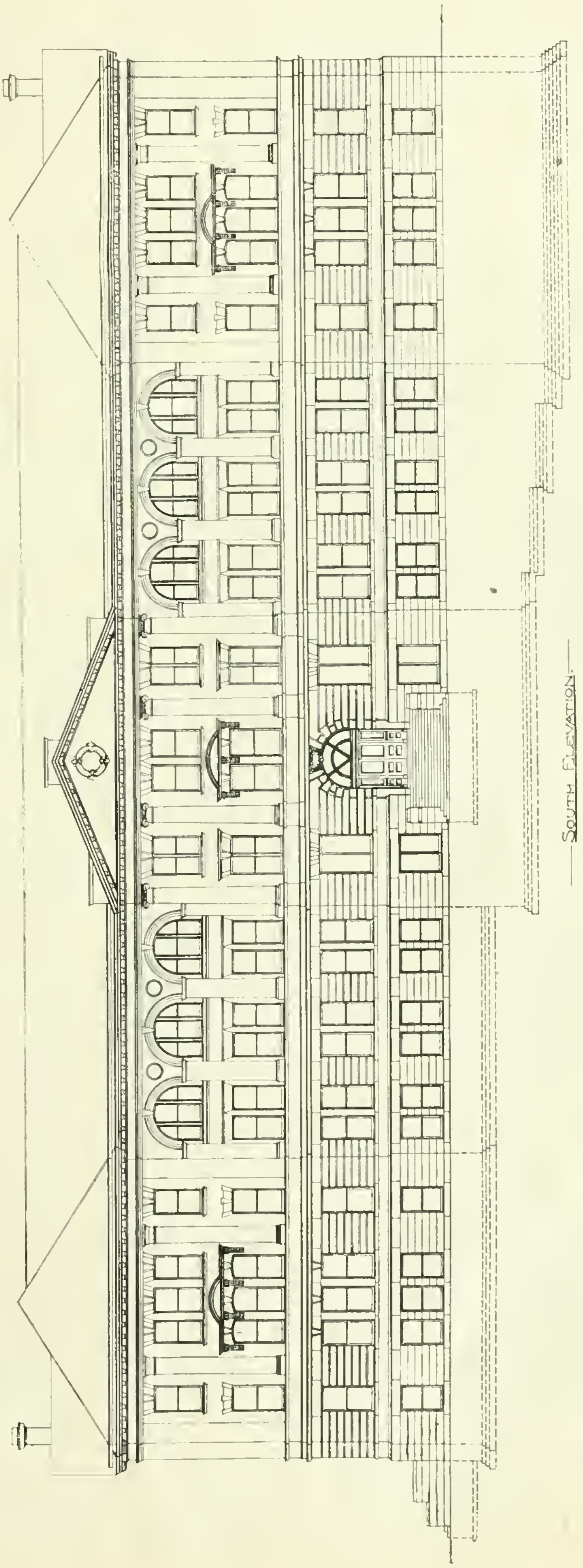
On concrete foundation walls now in place at the head of McCaul Street, Toronto, the Ontario government are proceeding to erect the brown stone and brick building shown in front elevation, in the annexed plate, as it will appear from College street. The plan will cover about 262 feet from east to west, with two wings, of which the western will have a depth of about 130 feet and the eastern 102 feet. It will be placed about 30 feet back from the street line. This building is for the accommodation of the Departments of Chemistry and Mining of the School of Practical Science. Students in all departments of the school will thus attend this building for all lectures and laboratory work in Chemistry and Metallurgy, as well as the students in Chemistry and in Mining Engineering. The accommodation provided in this building will also be made to suffice for the classes in Mineralogy and Geology in the Faculty of Arts.

In addition to a sab-basement for pipes, there will be four floors available for purposes of instruction and research. A main corridor runs east and west on each floor, from which access is obtained to rooms on each side as well as to the two wings of the building. Ventilating fans will be provided in the basement which will deliver fresh air, screened from dust, and warmed if necessary by steam coils to 70 degrees Fahrenheit, to the different rooms; but in winter the main heating will be done by radiators distributed through the building and used as required. The air will also be exhausted by fans in the attic when it is desired to have better ventilation. In this manner the ventilation and heating in each part of the building are separately under control.

The steam coils and radiators while in use will be supplied wholly or partly from the exhaust steam of an engine driving a D.C. dynamo, from which the ventilating fan motors will be supplied, as well as the current for lighting the new and the old building. At other times the usual city service will be used.

The museums for minerals and geological specimens will occupy an area about 50x80 feet in the east wing. In addition to lecture theatres, chemical, mineralogical and assay laboratories, metallurgical furnaces, and work rooms for fossils and minerals, lithology and crystallography, there will be a number of rooms for special purposes, such as calorimetry, gas analysis, toxicology, photography, electrolytic assay, fire-proof and constant temperature rooms. Of special interest to the readers of this paper are a series of rooms in the basement, marked on the plan: Junior Electro-Chemical Laboratory, Senior Electro-Chemical Laboratory, Electric Furnaces, Commercial Electro-Chemical Cells, and Storage Battery, respectively, with balance room and store room adjoining.

Next spring the Milling Building of one storey, about 75 feet square, will be begun on ground at present occupied by the old Wycliffe College building, immediately north of the centre of the new building. The Milling Building will be equipped with such appliances as are usual in modern milling laboratories, such as stamp mills, vanners, rolls, separators, leaching plant, etc.



School of Practical Science, Toronto: Chemistry and Mining Building.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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European Peculiarities. FROM our esteemed contemporary, the Electrical Review, we extract several interesting particulars regarding a hydraulic installation recently completed at Bienne, Switzerland, for the supplying of electric light and power to the surrounding district. The first is that the wheels, arranged in groups of four, and driving through direct connection to a 1100 k.w. alternator, are of the vertical style, and so necessarily is the generator. The practice over here would be to arrange the equipment horizontally, as the head is but 30 feet or less. Another peculiarity is that of the arrangement of the exciters, of which there is one for each alternator, direct (?) driven through two sets of bevel gears with their intermediate shafting, these in turn being excited from another direct current machine of comparatively small capacity, direct driven from a separate wheel. The reason given for this most extraordinary combination is the old story of good voltage regulation, changes in load on the alternators not disturbing the pressure as much as if the main exciters were self-exciting. Personally we would much dislike to have to be responsible for the continuity of a service supplied through such a train of operations as this arrangement involves, compared with the simplicity of one direct-driven, self-excited, compound-wound exciter capable of supplying the whole, or a large part, of the station, which is current practice here to-day. Another point on which the system differs materially from our methods is that all the lighting, which forms no inconsiderable part of the total load, being 950 k.w. out of a total of 2100, is single phase and connected all to one phase. On this side of the water the man who knowingly put over 60 per cent. of his load onto one phase, when it was practicable to make an almost perfect distribution, would be looked upon with curiosity and awe.

Starting Synchronous Motors. FOLLOWING up our remarks in last issue on this subject: If the normal voltage of the line were thrown onto the motor when at rest it would result in a current flow of two to three times the normal load of the machine, or possibly more, depending on the design of the particular plant in question, with its attendant voltage disturbance and fuse blowing all over the system, and to obviate these difficulties and as an alternative to the starting motor, a compensator is installed. This device is a species of transformer, equipped with a double-throw switch which in one position connects the motor to a voltage ranging from 30 to 70 per cent. of normal, depending on the starting effort required, while in the other it disconnects the compensator windings and applies the line potential direct to the motor. When the synchronous motor can be installed so that all or nearly all of the load can be disconnected from it until the machine is running, the starting torque required being comparatively small, the compensator method will prove the most desirable system for starting, eliminating as it does all moving apparatus other than the synchronous motor itself, and also being somewhat more simple to handle, as, the motor being connected to the line from the first, there is no necessity for phasing devices. As noted above, this system is suitable only in those situations where but small starting effort is required, otherwise the current drawn from the line becomes too large, in which event a starting motor will prove the more desirable. It should be noted in this connection that the induced voltage in the field of the motor may in some cases be so high as to render it inadvisable to adopt this method, and further, that it is not applicable at all to machines of the inductor type, which have no starting torque, but which must be first brought up to synchronism by a starting motor.

Westinghouse Single Phase Railway

At a meeting of the American Institute of Electrical Engineers, held in New York City on the 26th of September, Mr. B. C. Lamme presented a paper covering the outline of the new system of single phase railway apparatus for which the Westinghouse Company has just made its initial contract, and to which reference was made in our last number. The space available prevents our touching on but a few of the more interesting points. The frequency of the system is $16\frac{2}{3}$ cycles, which was chosen because it made the construction of the generators more simple than would the higher periodicities, this point being especially valuable in this plant where a pressure of 15,000 volts is generated direct in the machines, the highest yet attempted. Further, it is interesting to note that alternative machines were quoted upon, though not adopted, which were to be wound for 20,000 volts. The low periodicity has the further advantage of much lessening the drop in the rails, which naturally is much increased over that in the direct current system, but on the other hand it leads to difficulty in the flickering of the incandescent lights, which was finally overcome by the use of a thick filament low voltage lamp, connected several in series. The motors will be series wound for 220 volts, and equipped with a commutator similarly to the standard direct current machine, the statement being made that the enormous sparking, which has hitherto stopped all efforts to develop a motor of this class, has been overcome. This type of machine possesses characteristics not greatly different from those of the standard direct current motor of to-day, that is, it has the power of automatically varying its field strength, and therefore its speed, with changes of voltage and load, the most valuable characteristic of the series wound direct current machine. The various voltages applied to the motors to obtain different speeds are produced by an induction regulator, similar to those used in central stations, which is connected to the 320 volt tap of a 1000 volt compensator or auto-transformer wired between the trolley and the rails. This regulator has a maximum boosting or choking range of 100 volts, which subtracted from the 320 volts of the compensator gives about 200 volts, the minimum found necessary for smooth starting, added to it producing some 420 volts—the maximum required for two motors in series. The great advantage of this method of control, compared with direct current working, is that there are no moving contacts and no circuits to be opened except when the current is completely interrupted for stopping. The four motor fields are permanently connected in two parallels of two in series each, the armatures also being similarly wired, this allowing the use of but one reversing switch.

The starting and slow speed efficiencies of the car will be much better than those of the standard direct current equipments, as no rheostats are needed, the voltage being varied as before described by an induction regulator. The line efficiency will also be improved, as the voltage is 1000 as against the 500 obtaining in the other system. Also there will be a further gain in the substations, where the losses in the rotaries or motor generator sets will be eliminated. Against these must be put a somewhat lower full speed efficiency and a greater rail drop. On the whole the system is guaranteed to have a combined efficiency equal to or better than a direct current plant using rotary converters, the average power factor being estimated at 86 per cent.

Is Your Wiring Safe ?

There have been a great many fires lately in Canadian cities whose origin has never been satisfactorily determined and which have consequently been blamed on that force, to the layman so mysterious and uncontrollable, which is called electricity. The popular verdict may be right, or it may be wrong, but the fact remains that a large proportion of the electrical installations in this country, more especially the older ones, are in a state so dangerous that it is simply amazing. As instances may be cited a warehouse which, devoid of attendants 90 per cent. of the week, and filled with cotton and woollen millstock, was wired without an entrance switch and equipped with the ordinary link fuses, absolutely open. The chances of a melting fuse igniting the bales not over eight feet away and directly below them were so great as to amount almost to a certainty, in fact the woodwork bears evidence of one fire which has already occurred and which was due, so we are informed, to electrical causes. Another case is a church in which the wiring, ramifying all over and through the building, mostly wood, and minus any attempt at bushing either with porcelain or even rubber at the many points where it passes through walls and floors, is supported by wooden cleats in its many wanderings past gas, water and furnace pipes of all descriptions. Investigation would probably show many such installations as these; is it any wonder that fires occur in them? Rather is it not a source of surprise that so few fires occur, especially when we consider the many chances that exist for line crosses, transformer breakdowns and lightning discharges bringing into the building potentials which are not only much greater than can be controlled by the insulation of the circuits, but which in addition are dangerous to life. A stitch in time saves nine ; if you are a consumer why not spend the comparatively small amount necessary to put your wiring in good shape, at any rate have it periodically inspected ; if you are a producer look carefully to your own lines, especially those in the station itself, in addition urging upon your customers the necessity of keeping careful track of the electrical material, both new and old, both machinery and wiring, which they may from time to time have upon their premises. If these precautions are taken, the public will gradually become less skeptical of electricity as a fire hazard. There is no reasonable man who does not acknowledge that electrical illumination and electrical power, compared for instance with oil and gas, are not only the most artistic and convenient, but far and away the safest, it therefore behooves us all to see that as far as in us lies, due precautions are taken that the enemy be not given cause to blaspheme.

QUESTIONS AND ANSWERS

A. H. Moore, Sunderland, Ont.: Kindly answer in your November edition, how many gallons of water per hour should it take to run a simple high speed engine running 250 16 c. p. electric lights.

Ans.—Assuming that each lamp consumes 60 watts, the total power delivered to the load will be 15 k. w. or 20 h. p. Allowing for 10 per cent. loss each in the line, dynamo, belting and engine, the indicated horse power of the latter will be almost exactly 30 h. p. An ordinary high-speed engine of this size, non-condensing, will consume about 40 pounds or 4 gallons of water per horse power hour, which would make the total consumption for the load you specify, assuming that no extraordinary conditions are present, 120 gallons per hour.

"Electrician": Why is the air gap on an induction motor made so small, especially when compared with that of a synchronous motor?

Ans.—The depth of the air gap determines the resistance of the magnetic circuit, and thus the magnetizing current required, and as this magnetizing current in turn largely determines the total current required by the motor to produce a given horse power, it will be seen that the smaller the air gap, other things being equal, the less the current input for a given power output. It is, of course, highly desirable to keep this current down to the smallest amount possible, as it not only affects the size and consequently the cost of the motor itself, but also those of the transformers, line and generators. In a synchronous machine, the magnetization is produced by direct current from an exciter, and thus does not affect the alternating current input so materially; the air gap is then made larger so that there may be a greater latitude allowed for wear in the bearings, variations in the size of the armature and the bore of the field, etc.; without encountering difficulties by the armature rubbing against the field.

W. J. Moore, Meaford, Ont.: How would I recharge dry cells? I have a direct current 110 volts $1\frac{1}{2}$ k. w. machine and also an arc machine giving 6 amperes, and voltage various with number of arc lamps burning (series arc.) Could I recharge cells from this source?

Ans.— The most usual way of charging cells is to put them across a 110 volt machine, all in series, and also put in series with them a sufficient number of incandescent lamps to pass the charging current required. This can be ascertained, for the ordinary types of batteries, by adjusting the circuit until the voltage is about 2 volts across each cell. They could also be charged from the arc circuit by connecting them into it all in series and putting in parallel with them a resistance adjusted so that you get about 2 volts across each cell, though it is scarcely desirable to do work of this kind in connection with a high potential circuit.

An Eastern lighting company wish to know what they can do to run a direct current motor of 220 volts from a 500 volts direct circuit. They require both voltages at same time.

Ans.—The only possible way is to put a rheostat in series with the motor which will have a resistance sufficient to cut the voltage approximately in half, and which will have a current capacity equal to that of the motor. This method will be fairly satisfactory if the load on the motor does not vary, but if it does the speed will keep constantly changing, and the motor may be damaged, particulary the fields, which may get extremely hot. It should be noted that this is a very inefficient method of working, as just as much energy is wasted in the rheostat as is utilized in the motor.

"R.S." writes: Would you please explain to me reason for the statements so often made that it is not profitable to run incandescent lamps more than a certain length of time, why not leave them burning till they actually give way. Does the consumption of energy or current increase as the lamp grows older?

Ans. — If it were possible to manufacture a lamp which until it actually broke gave the same candle power and took the same current as it did when new, the pratice of renewing lamps after they got a certain age, instead of leaving them till they burnt out, would be entirely wrong, but the point is that the ordinary commercial lamp, to a greater or less extent, depending on whether it was originally of a poor or good quality, deteriorates materially in its light giving power after burning a certain number of hours, this deterioration not being accompanied by a corresponding decrease in the energy which it consumes; for instance a 16 c.p. lamp may be found to be giving but 10 c.p., which is only about 63% of its original rating, and still be consumming 90 to 95% of the current which it did when first put on the circuit. Obviously, if 10 c.p. is enough light, you should put on a 10 c.p. lamp, which will consume but about 70% of the energy taken by the old 16 c.p. The energy consumed by incandescent lamps does not increase as the lamps get older, tending rather to slightly decrease, though not to any marked extent.

"Student": What is meant by the effective weight of the lever of a safety valve? What is the rule for finding it?

Ans.—By effective weight is meant the actual weight with which the lever, pivoted at the heavy end, bears down upon a point placed the same distance from the pivot as the centre of the valve is from the fulcrum, in other words the weight with which the lever alone tends to bear bown upon the valve, when placed ready for service. The rule for finding this weight is: Balance the lever, and measure the distance from the point where it balances to the fulcrum, multiply this by the weight of the lever, and divide by the distance from centre of the valve to the fulcrum. The actual total weight on the safety valve is that of the weight multiplied by the leverage it has, plus the weight of the valve itself, together with the effective weight of the lever.

"Reader": What is the maximum permissible overload of the ordinary direct connected unit?

Ans.—The maximum output or overload is usually determined by the engine, which can seldom keep the machine up to the requisite speed under much more than 25 or 30% overload, though this is really determined by the steam pressure. As far as the dynamo is concerned you will find that machines of standard make will carry 50% more than their normal capacity for say three or four hours without heating to an injurious degree, a momentary output of twice their normal without sparking beyond a reasonable amount.

ELECTRICAL ENGINEERING AT THE SCHOOL OF PRACTICAL SCIENCE.

The students in the Department of Mechanical and Electrical Engineering at the School of Practical Science, Toronto, this year number 160, of whom eighty are registered in the first year, out of a total of 142 students in that class. The total number of students now enrolled in all Departments of the School is 340, which corresponds to an increase of about fifty per cent. as compared with two years ago. The same proportion of increase is found in the students in the above Department.

Owing to this large gain in numbers the stuff has been increased this year by the appointment of H. W. Price, B.A.Sc., as Demonstrator in electrical engineering. Mr. M. V. Sauer is this year Fellow in electrical engineering.

Considerable additions are being made to the equipment, particularly for the study of the alternating current. Among these may be mentioned a Wagner single-phase motor, a General Electric 7½ h. p. experimental polyphase induction motor, which can by substitution of a revolving field be used also as a polyphase dynamo, and a constant current transformer for series arc lighting, made by the General Electric Company, regulating at 6.6 amperes. We might also mention a large Braun vacuum tube with translucent cross-sectioned screen, which by the motion of the projection on it of a deflected cathode ray indicates the instantaneous values of current and voltage. A McFarlan-Moore vacuum vibrator apparatus for the illumination of vacuum tubes, a Simon's singing arc lamp and other minor apparatus, as well as a considerable addition to the list of Weston and Thomson instruments, have been purchased.

There is no immediate likelihood of change in the course of study, though a sub-division into two courses, namely, mechanical engineering, and electrical engineering, will probably before long become desirable. It would appear also that in order to gain the fullest possible advantage from the new building of the School of Practical Science now being erected for Chemistry and Mining, it may be wise to increase somewhat the latitude with regard to options. A description of this building appears elsewhere in this issue.

HOT WATER HEATING FROM A CENTRAL STATION.*

By E. H. McKnight.

Owners of electric light plants have long desired to increase the earning capacities of their properties without appreciable additional expense. This has lead to an investigation of the utilization of exhaust steam as a means of heating buildings. Wherever this business has been added to an electric light plant it has proven its salvation, especially where competition has been keen and profits small.

The purpose of this paper is to give a general idea of the equipment and operation of such an enterprise.

Details of Construction.—Pumps and condensers, or heaters, an expansion tank and a catch-all constitute the equipment of the station. Large duplex pumps are used to circulate the water about the system. They are operated at a low pressure during moderate weather, but in extreme cold weather the pressure is increased.

An open tank of sufficient capacity is placed at an elevated position, and used as an expansion tank for the system. Any good condenser or open heater into which the exhaust steam from the engines is turned can be used. The condensation formed is conducted back to the boiler by means of a small automatic pump, furnishing a quantity of heated water free from impurities, the oil having been extracted by means of the catch-all. The water for the heating system is pumped under pressure into the condensers or heaters, and becomes heated, passing out of the condensers or heaters and continuing its travel about the circuit. The condenser should be of ample size to heat sufficient water to care for the amount of radiation installed. A continuous and uninterrupted service during the heating season is assured by having all station equipment in duplicate.

The Mains.—Upon leaving the station, from eight to twelve-inch pipe is used, this depending upon the capacity of the system; the size of same is reduced at intervals until the end of the line is reached. The two pipe system has many advantages, in my opinion, over a single-pipe system; one pipe being used for the supply, and the other for the return. With this arrangement water is brought directly into each building from the heating apparatus, not having passed through any other building.

The insulation of the mains is a matter which necessitates much care and attention. The material which has been found to be the most efficient and inexpensive consists of hemlock boxes, built with double air-tight compartments in which the mains are laid; the space remaining about the pipes being well filled with process shavings or mineral wool. The outside of the boxing is protected by a prepared building paper.

Where this kind of insulation has been used the loss of heat on the line amounts to not more than 15 to 20 degrees; that is to say, when water is sent out at 180 degrees, it will return to the plant at 160 degrees. Thus when this water is raised from 160 degrees to 180 degrees, it is ready to send out again. Care should also be taken in anchoring the mains and providing for expansion.

Cost of Operation.—The expense of operating the heating plant under ordinary conditions is not great, the principal expense being in the amount of live steam used to operate the circulating pumps, which at no time is any great amount, the total for the entire heating season being a comparatively small item. No extra labor is needed at the plant, since what little attention the heating plant may require can be given by the same force of men heretofore employed at the electric light plant.

In order to fully realize upon the investment at the earliest possible time, it is most desirable to secure the services of one who is thoroughly conversant with the details of the business and familiar with the method of figuring for the purpose of making contracts for the heating of every available building located upon the pipe line.

As soon as the capacity of the pipe line has been reached, this additional expense can be dispensed with.

Method of Figuring.—The rules used are the same as those given by the highest authorities on the subject of heating, and are the same as those which have been in general use for a number of years.

In determining the amount of heat a given building will consume, measurements are taken of the cubic contents of each room, it being assumed that the atmosphere of a room changes once and must be reheated. The square feet of exposed glass surface is also measured, the loss of heat through one square foot of glass being 75 times as much as the heat consumed by one cubic foot of air. Next the square feet of exposed wall surface is taken, it being estimated that ten square feet of wall surface, in the average well-built house, will lose as much heat as one square foot of glass surface.

By this means we arrive at the total number of feet of radiating surface to heat a given building, allowing one square foot of radiating surface for every hundred feet of cubic contents or its equivalent. An erroneous impression has gone forth to the effect that the heat is charged for according to the number of feet of radiation used, whether this be much or little; but in reality the cost per year is governed by the amount of heat the building will consume, and is not based entirely upon the number of feet of radiation contained in it. It is a well-established fact that hot water as a heating medium is far superior to all known methods of heating. Among the numerous advantages to be had from this particular method is the fact that during the fall and spring months when a moderate amount of heat is desired, this need can be supplied by circulating the water at a low degree of temperature.

The heat from such a system is supplied to the consumer 24 hours a day, and every day upon which heat is needed; the service being continuous and uninterrupted, it gives the consumer the least concern. A crowning feature of this system of heating is obtained by the use of heat regulators, one or more being placed in each building. This insures an even, regular temperature through the house at all times.

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*Paper read at the Eighth Annual Meeting of the Ohio Electric Light Association.

TELEGRAPH and TELEPHONE

SPACE TELEGRAPHY.

The Cape Breton station that is to be used for the transmission of Marconi space-telegraphy messages across the Atlantic is now almost completed. The station is located at Glace Bay, on the eastern coast of Cape Breton, on a promontory about 70 feet above mean high water.

The plant consists of four huge towers for carrying the vertical wires, and a group of one-storey buildings arranged at the base of the towers in which is contained the powerful electrical plant which has been specially constructed for the station.

The necessary height for the vertical wires has been attained by the erection of four braced wooden towers, each 215 feet high, at the four corners of a square which measures about 200 feet on a side. Each tower consists of four legs, built up of three by 12-inch plank, the legs being braced together on each face of the tower by three by nine-inch braces. The planking of which the legs are built is laid up so as to break joints as much as possible and secure the approximate strength of a solid 12 by 12-inch stick. The legs are spaced 30 feet from center to center at the base and nine feet from center to center at the top platforms. The foundation of each tower consists of a mass of concrete formed in a hollow square, in which are embedded the 12 by 12-inch sills and the first panels of the lateral bracing. In section this concrete mass is six feet in width by eight feet in depth, the external dimensions of the foundation being 36 by 36 feet, and the internal dimensions 24 by 24 feet.

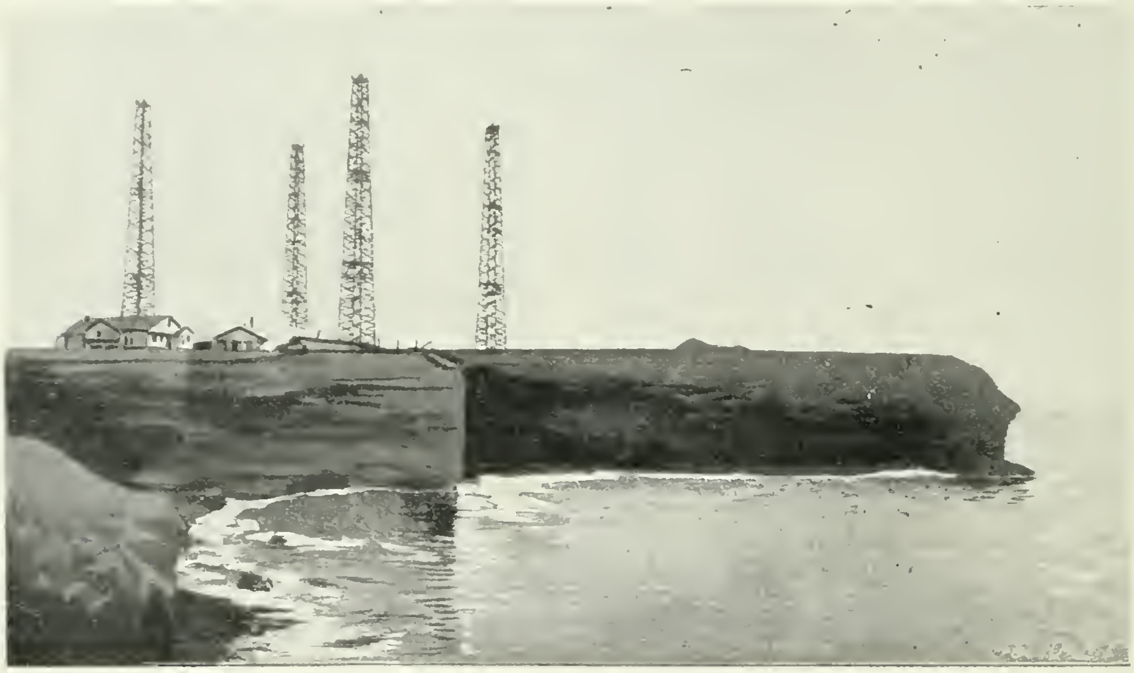


Fig. 1.—Marconi Wireless Telegraph Station, Glace Bay, Nova Scotia.

The towers are tied in such a way that the stress on each tower will be transmitted directly to its own set of cables, every one of which will be doing useful work. The wires are carried from three points on the towers (the lower and upper third and the summit), all wires having an inclination of 45 degrees. The ropes are all made of the best plow steel, the majority of them being 2½ inches, and a few three inches. The method of carrying the aerial wires upon the structure is as follows: Four three-inch cables are strung from platform to platform at the top of the towers, as shown in the diagram (Fig. 3), and from these cables depend 150 aerial wires. These are drawn together and united in the center of the tower into a single cable, which descends vertically to enter the transmithing and receiving house below. The average length of the aerial wires before they meet in the common central cable is about 140 feet.

Mr. Vyvyan, the engineer in charge of the station, states that Marconi has ceased to use the coherer and has substituted a receiver of much greater reliability and capacity. It was always difficult to secure an absolutely reliable coherer of the old type, since out of a hundred of these little instruments 30 or 40 might be good, 30 would be poor and 30 would be absolutely unusable. The new method of receiving adopted by Marconi has a capacity, should it be required, of several hundred words a minute.

The power of the new installation is said to be far greater than would be demanded for transmission to Europe, and it is announced that before the close of the present year messages may be sent direct from Cape Breton or Cape Cod, Mass., to Cape Town, South Africa. It is expected that Mr. Vyvyan, after he has placed the station in operation, will leave for South Africa, where he will superintend the erection of a wireless station at Cape Town. The plan of the Marconi company is to establish, as soon as possible, a chain of long-distance wireless stations in different parts of the world. Within a year, it is expected, there will be one station in Canada, two in the United States, one in Central America or the West Indies, one in South Africa, and one on the continent of Europe, besides the present one at Poldhu, England.

In a recent paper read before the Engineers' Club of Philadelphia, some particulars were given of a method of wireless telegraphy worked out by Professor Fessenden, of the United States Weather Bureau. It consists of a receiver entirely distinct from the coherer—in the main of a platinum wire of peculiar form and character. The sensitive part of the receiver is a continuous conductor and does not depend for its operation, like the coherer, on a vast number of loose contacts. Each time the electrical oscillation passes along the circuit in which the Fessenden receiver is placed a change occurs in the electrical condition of the circuit. This change of condition manifests itself as a click in the telephone receiver. One click is produced each time a complete oscillation passes along the wire; or, in other words, each time the secondary spark occurs at the sending station. If these interruptions are slow, the clicks are difficult to interpret. As the number of interruptions increases the individual clicks form themselves into more or less of a buzzing sound; and if the interruptions are made with a tuning fork, for instance, the telephone receiver will produce the same tone as the sending mechanism gives out. It will be seen that this arrangement lends itself, with slight modifications, to a telephonic system, details of which are not yet ready for publication. General Greely, of the United States Signal Corps, has given a contract to a Philadelphia firm to install the system for the Signal Corps in Alaska, between Cape Nome and St. Michael, a distance of 108 miles across Norton Sound.

An electric light plant is being installed for lighting the municipality of Vernon, B. C. The engine will be supplied by the Waterous Engine Company, of Brantford, Ont.

WIRELESS TELEGRAPHY ON A MOVING TRAIN.

During the passage of the special train on the Grand Trunk Railway between Toronto and Montreal, on October 13th, bearing the members of the American Association of General Managers and Ticket Agents from Chicago to Portland, wireless telegraphic signals were received by the party as the train passed St. Dominique station, at the rate of 60 miles an hour. No special attempt was made to signal to a great distance, but the train remained in touch with the station for from 8 to 10 miles.

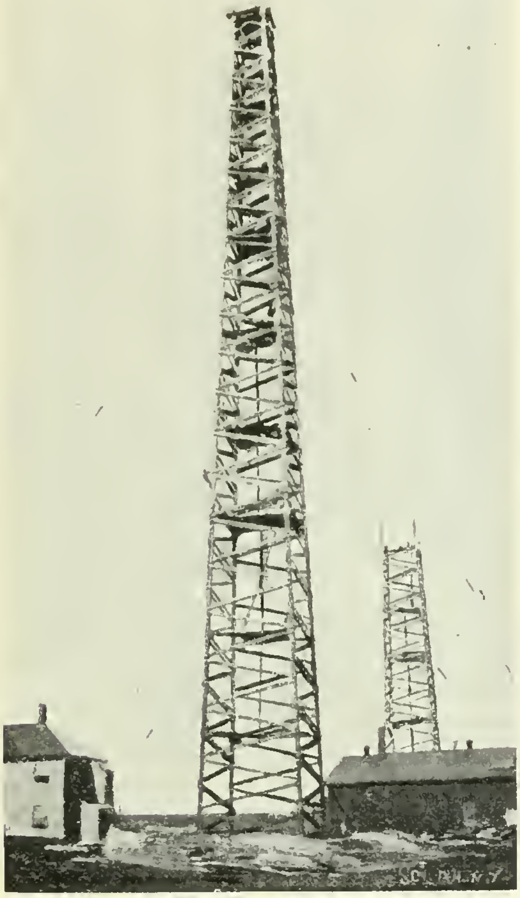


Fig. 2.—One of the Marconi Towers, Showing Details of Construction.

Two vibrators, 10 to 12 feet, connected with an induction coil of the usual pattern (8-inch spark), served to transmit the waves from the station, while on the train itself the waves were received by a coherer of the ordinary type. A relay rendered the signals audible to the passengers by ringing bells in three cars. The collecting wires were run through the guides for the signal corp inside the train, and extended about one car length on either side of the coherer. Owing to the natural vibration of the train it was impossible to have the relay at the most sensitive point, but the distance to which it was possible to keep the train in touch with the station was considered very satisfactory by the various officials. The apparatus was loaned for the experiments by the Physical Department of McGill University, Prof. E. Rutherford and Prof. H. T. Barnes, assisted by Mr. H. L. Cooke, being present to look after the adjustments. Dean Bovey and Prof. C. H. McLeod, of the Engineering Department of McGill, also witnessed the experiments.

SHORT-CIRCUITS.

The Bell Telephone Company are considering the building of a telephone line between Clayton and Almonte, Ont.

The shareholders of the telephone Company at Harrietsville, Ont., have elected the following officers: President, Dr. W. Doan; secretary and treasurer, James Smith.

The Eastern Telephone Company have just installed a new relay switch-board at Sydney, N.S. The board was supplied by the Northern Electric Company, of Montreal, and installed under the superintendence of Mr. Norris.

The Canadian Telephone Machine Company, which obtained a charter at last session of Parliament, is arranging to establish its headquarters in Ottawa. Toronto and Ottawa capitalists, including Hon. George E. Foster, are interested. The system obviates the necessity of having a central telephone exchange. By taking down from an indicator the figures representing the number with which connection is desired, the same can be obtained without ringing up a central office. It is probable that an experimental line will be established in Ottawa.

Cable dispatches from London, of September 19, gave the following: At a conference with Signor Galimberti, Minister of Posts and Telegraphs, William Marconi submitted plans for the erection of a wireless telegraph station, to cost $140,000, for establishing connection from Italy with the British and American stations. The scheme will be submitted to Parliament. King Victor Emmanuel has bestowed the Cross of the Order of the Crown on Marconi. The French Government has decided to install a wireless telegraphic system in the islands of Martinique and Guadeloupe, owing to the frequent interruptions of the cable service there.

PERSONAL.

It is understood that Mr. J. J. Toole, of Brantford, has accepted the position of general manager of the new Brantford-Paris electric railway.

Mr. Frank Turner, C. E., of Toronto, has accepted the presidency of the Central Ontario Power Company, of Peterborough. Mr. Turner has had a wide engineering experience.

Mr. T. H. Burgess, for the past ten years connected with the Halifax Tramway Company, has been advanced to the position of inspector, an office just created and which is expected to result in the improvement of the service.

Mr. Sylvester Potter, who recently tendered his resignation as chief electrician for the Toronto Railway Company, has accepted a lucrative position in Chicago. Before leaving Toronto the employees of the company contributed generously towards the purchase of a souvenir to mark the high appreciation they entertained of Mr. Potter and the cordial relations that has existed between them. The gifts consisted of a handsome travelling case and a gold chain and locket.

A pretty wedding occurred on October 21st, when Miss May Isabel Crawford Dickson, daughter of the late George D. Dickson, K.C., of Belleville, became the bride of Mr. Roderick J. Parke, consulting electrical engineer, of Toronto. The ceremony took place in St. Alban's Cathedral, Toronto, and was performed by Rev. Canon MacNab. A reception was held at the home of the bride's mother, 1 Howland avenue, after which Mr. and Mrs. Parke left for New York and the Eastern States.

Stricken with appendicitis as he was preparing to sail for America, Prof. Sidney Howe Short, inventor of the first electric car operated in the United States and consulting engineer for Dick, Kerr & Company, London, England, died at his home in London on October 21st. He was 43 years old and had been engaged in electrical work for the last 24 years. Born in Ohio, he was graduated from the Ohio State University in 1878. He established the Short Electric Railway, of Columbus, and at one time was connected with the Walker Electric Company, of Cleveland. He was a professor in Denver University for several years, during which time he invented an electric car, which was tested on the University grounds. Prof. Short, it is said, patented nearly as many electrical appliances as has Mr. Edison.

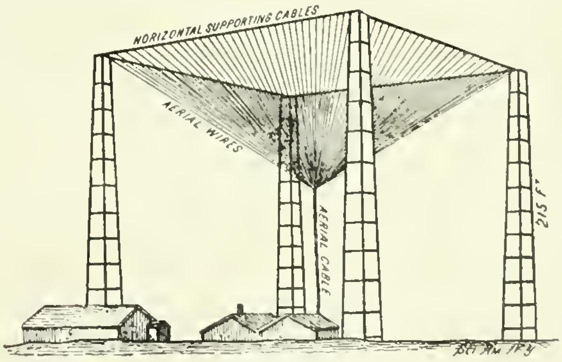


Fig. 3.—Marconi Station.—Method of Carrying Aerial Wires.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, October 31st, 1902.

The novel scheme spoken of in last issue as going to be adopted by the Electrical Contractors' Association for the province of Quebec re. inspection of interior electric wiring is as follows :—Until such time as the city of Montreal appoints an official inspector (which course is also being worked up by the Electrical Contractors' Association), the members have made an agreement with Mr. W. J. Plews, whose certificates are accepted by the Canadian Board of Fire Underwriters, to inspect all electric light work done by any of its members. A motion to this effect was put and carried at the last meeting of the contractors and arrangements were made with Mr. Plews to carry it into effect on or about October 15th. This voluntary act ought to prove good faith as well as be acceptable to any fair-minded customer. It is hoped that the electric light supply companies will assist this movement by demanding certificates before making connections from other wiring contractors outside the association.

Some local wiremen seem to have got it into their heads that the Electrical Contractors' Association is anti-union and some business men treat it as a combine. Be it known to the former that the association is neither for or against the union, and to the latter that apart from rate per hour to be charged for labor, there is no combine of any sort. The object is to better electrical conditions and assist electrical development. Naturally, so as to control votes to that end only, a union man is not eligible for membership. The success of the association already on the inspector question with the city of Montreal during the few months of its existence is commendable and proves its objects. I quote from one of the dailies : "It is just possible Montreal may have a bureau of inspection for electric wires. It is now suspected that defective wiring is the cause of a great many mysterious fires, notwithstanding the fact that the officials of the electric companies usually protest against statements of this kind. The matter has been given little or no attention up to the present time, and it is now proposed to see what can be done. City Electrician Badger presented a report in favour of establishing a system of inspection at yesterday afternoon's meeting of the Fire Committee. Mr. Badger explained that the cost of a properly equipped staff would be considerable, but he thought a few thousand dollars would do for a start. A sub-committee was appointed to study the matter with instructions to report as soon as possible.

The case taken by several insurance companies against the Lachine Rapids Company, referred to in last issue, promises to be a big fight. It is on account of the fire at Ayer's cold storage warehouse. It is alleged that the fire was electrical and due to high tension current entering from the Lachine circuit during break-down of transformer. It looks as if every electrician of note in Montreal will be called in on one side or the other.

Fogarty Bros., Montreal, have secured the contract for installing a complete electric light plant in the new mill of William Rutherford, Sons & Company at St. Henri, Que.

The city of Winnipeg now owns its fire alarm system, recently installed under the supervision of Mr. F.A. Cambridge, city electrician. For the past eighteen years the system has been operated by the Bell Telephone Company. The principal improvement introduced in the new system is the substitution of insulated wire for the bare wire hitherto in use ; another improvement is the subdivision of the boxes into a greater number of circuits Provision is made for the introduction of the manual system instead of the automatic repeater, but this change may not be made for some time. The switch-board in the operating room is 7.10 by 6.5 inches, of red Tennessee marble, manufactured by the Western Electric Company, of Chicago. It has a capacity for eight circuits, six now in use and two spare circuits. Each battery, when fully supplied, has a capacity for 48 hours' supply. Current is obtained from the electric plant of the Hudson's Bay Company. The outside system comprises 40 miles of wire, most of which is heavily insulated. There are at present connected to the system 83 boxes, and 10 additional ones have been ordered.

ANNUAL DINNER OF STATIONARY ENGINEERS.

The usual jolly crowd assembled at the Walker House on Thanksgiving Eve, October 15th, to participate in the sixteenth annual banquet of Toronto No. 1 Canadian Association of Stationary Engineers. The large dining hall was capable of providing no more than ample accommodation for the large number of engineers and their friends. The menu card was prefaced with the quotation "Hunger is sharper than the sword", as if to whet the appetites of the party, but such was not necessary, as the dainty viands were a sufficient enticement in that respect.

The duties of chairman devolved upon Mr. R. H. Johnston, President of Toronto No. 1, who lost no time after the supper in proceeding with the programme of toasts and song. After "The King" had been duly honored, Mayor Howland, who had just entered the room, was asked to make some remarks. He complimented the engineers upon the splendid gathering, and announced himself to be in sympathy with the aims and objects of the Association. The name "stationary engineer" seemed to him a misnomer, as engineers were not stationary but were making rapid advancement. Upon concluding his remarks he was warmly applauded. Coupled with the toast "Toronto, the Queen City", was the name of Ald. Woods, who made a somewhat humorous speech.

"Our Guests" called for remarks from G.B. Towers, J.J. Bell, and Capt. Donnolly. Capt. Donnolly has recently removed from Kingston to Toronto. He has been prominently connected with shipping and marine engineering and was for several years inspector for Lloyds, of London, England. It was time, he said, that the engineers had obtained greater recognition in this country. It was most necessary that an engineer should be capable of efficiently performing his duties, as both life and property depended upon him. There has been no time in the past, he believed, when the good engineer is more sought after than he is to-day, and he urged every young man to strive to become absolute master of his business, whether it be engineering or otherwise. He thought every person who had anything to do with running an engine should join the engineers' association, particularly as its aims were educational.

Everyone smiled when Mr. J. J. Main rose to respond to the toast of "Our Manufacturers," but the expected story was not forthcoming. Mr. Main's remarks were confined to the boiler-making business, with which he is associated. He said present prospects could not be brighter. Every boiler-maker that he knew had all the business he could handle, and many of them were in the happy position of being able to discriminate as to the work which they would accept. He regretted to say that there were many defective and worn-out boilers still in use. He knew of boilers that had been condemned and replaced by new ones, and these same boilers had been sold for saw mills and other purposes where 100 pounds pressure or more would be required. There could be only one result—a disastrous explosion sooner or later. Mr. Main had recently returned from a convention of boiler-makers at Atlantic City, N. J., where he had the honor of being the only Canadian present. Mr. Baker, of Westman & Baker, and Mr. Owen, of London, England, also spoke in response to this toast. To the toast of "The Executive" Mr. H. E. Terry and Mr. A. M. Wickens replied. "Toronto No. 1" was then toasted and responded to by the president, Mr. R. H. Johnston.

The musical programme was provided by Messrs. R. A. L. Gray, McLean and Fletcher.

The committee in charge of the dinner were unceasing in their efforts to entertain their friends, and they succeeded admirably. This committee was composed of R. H. Johnston, president; G. C. Mooring, chairman; James Bannon, secretary-treasurer; Charles Moseley, A. M. Wickens, N. V. Kuhlman, W. H. Johnston, W.A. Woodbridge, James Huggett, and A.J. Butcher.

The Otonabee Power Company, of Peterborough, Ont., turned on the power in their new plant on September 23rd. The power house is located about four miles north of Peterborough, and the present installation has a capacity of 2,000 horse power. The water wheels consist of three 68-inch Samson turbines, of the verticle type, manufactured and installed by the William Hamilton Manufacturing Company, of Peterborough. The generators and other electrical apparatus were furnished by the Canadian General Electric Company.

BY THE WAY.

Under the title of "Dooley's Invention," a Montreal correspondent sends us the following, with apologies to F. P. Dunne :

" Dhrink up yer beer Hennessy an shep into me labortory," said Mr. Dooley. " An ilectric shock 'll do yer owld lame back more good than anything Oi' can think iv. 'Tis in here thot me friends Edison, Marconi, Frid Thomson, Gawrge Hill, an' a few others akelly as much, do be meetin' twist a week fer to perfect th' noo invintion which Oi 'ave been workin' on fer years.

" Wudden't ye be sorrphrised Hennessy, on a warm day at th' mills, if ye just thot iv a cool schooner, an' it all 't wanst, lo and behold, it just popped down before yer thirsty face? Or make up yer moind any toime in th' day that 'tis six o'clock an' immegitly th' whistle 'd blow ? If ye can stretch yer immagination to that extent ye have me invintion iu a nutshell.

"Av coorse, when Oi git it on th' market, 't'll be neat an' convaynient fer carryin' in yer vist pocket, but don't ye buy th' insthrument till Oi giv ye a few demonstrations, fer ye'd be shure to wish fer a house an lot an it 'd come down so quick that th' owld woman 'd 'ave t' hire a dridge fer to dig ye out.

" Oi bet me brain looks loike a magnified dhrop iv Montreal wather since Oi'v been calculatin", studyin' an expiriminting'. 'Tis great spoort Hennessy,

$$A = \frac{12 \times 1lm \times At}{Eb—e} \quad S = \frac{119 \times 60 \times 10^8}{252 \times 2,950,000} = \text{Oi dinnaw.}$$

Ye see $C = \frac{E}{R}$ is about wan iv th' first things ye run up aginst. Av coorse th' rise in timperature increases th' resistance, th' same as t'would in yer own case Hennessy, much depindin' on th' lingth av th' circuit an' th' toime ye've sthopped at it. Ye've loikwise to consider th' dhrop in potential, b't after ye've raised the E. M. F. at th' ginerator things 'll commince fer t' feel aisy fer ye if ye can make up yer moind thot ye've sufficient margin, an' thin yer all roight fer Sunday.

Call agin Hennessy, I'll enlighten ye more if ye feel intherested. Oi niver knew befoor that ye cud divide an E by an R, ses Hennessy.—R"ats.

THE LATE MR. JOHN MOODIE.

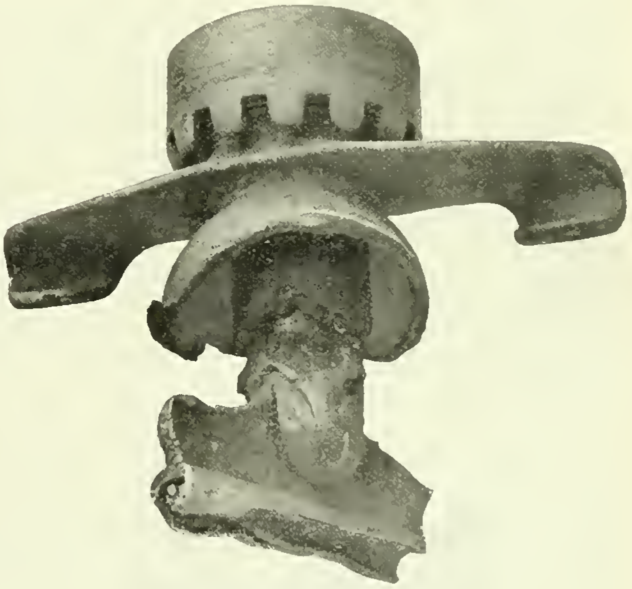
One of the prominent citizens of Hamilton, Ont., in the person of Mr. John Moodie, Sen., passed away on October 19th at his residence, "Blinkbonnie", Bay street north, in that city. Mr. Moodie had been indisposed for several months, and his demise was not unexpected. He was a well-known business man and had been prominently connected with the industrial development of Hamilton and in late years with its advancement electrically.

Deceased was born in Newton-Steward, Ayrshire, Scotland, and came to Hamilton when twenty-two years of age. Thus forty-six years of his life were spent in that city. He conducted a large fancy goods store and, with his sons, founded the Eagle Knitting Company. About eight years ago he retired from these enterprises, leaving them entirely to his sons. Recognizing the possibilities in the electrical field, he became one of the founders and original directors of the Cataract Power Company, and at the time of his death was a large shareholder in the Hamilton Electric Light & Cataract Power Company. Mr. Moodie was treasurer of the company, but a few months ago, owing to failing health, his duties were transferred to his son, Mr. James R. Moodie. It is said that he left an estate valued between $450,000 and $500,000, a large portion of which is Cataract Power Company stock.

At a meeting of the Board of Directors of the Hamilton Electric Light & Cataract Power Company the following resolution was unanimously passed: "The Board of Directors of the Hamilton Electric Light & Cataract Power Company places on record an expression of its sincere sorrow and regret that John Moodie, the Treasurer of the company, has been called away from this life to his eternal rest. Mr. Moodie was one of the few pioneers in the history of this company's enterprises, and at all times showed the utmost confidence in the company's future prospects. His co-directors ever found it a genuine pleasure to be associated with Mr. Moodie in all business matters, and the company's success has been in no slight measure due to his acknowledged reputation in the community and business circles as a man of high character and undoubted integrity. The directors extend their warmest sympathy to the grief-stricken widow and the members of the family in the hour of their affliction and bereavement."

A REMARKABLE SPECIMEN.

The illustration herewith shows a straight line hanger and ear which were taken from the line of the Mill Creek Valley Street Railroad Company, St. Bernard, Ohio. The damaged appearance of the hanger and ear was caused by a dead short-circuit between the trolley and ground. It seems that in some way the positive trolley wire came into contact with the negative wire on one of the cars, causing a short circuit of the line. The circuit breakers, being set at 2000 amperes, would not open up until the engineer opened the circuit by pulling out the breaker, and a the time that was done, he noticed that the short circuit was carrying 150 amperes.



Damaged Hanger and Ear.

An examination of the cut will show the extremely disastrous nature of the arc caused by the short-circuit, which was sufficient to melt entirely away the ends of the trolley ear, and also the lower part of the skirt of the hanger supporting it. The hanger in question was a type D hanger, made by the Ohio Brass Company, of Mansfied, Ohio, and the insulation was its well known "Dirigo" make. Despite the fact that the hammer and ear were so badly damaged by the arcing that the stud bolt of the hanger was partially melted away and fused on to the boss of the ear, the insulation was practically uninjured, with the exception of a slight charring of it at the lower edge of the insulated bolt. A test of 500 volts afterward applied between the hanger casting and ear showed that the insulation of the hammer was still perfect, a tact which, in itself, speaks well for the heat-resisting and insulating properties of "Dirigo" insulation, which is sold in Canada by the Canadian General Electric Company, Limited.

A dispatch from Glasgow, Scotland, dated October 6th, stated that the Clyde Valley Electrical Company had placed a contract with the Westinghouse Electric Company for the equipment of two generating stations to supply power for industrial purposes over an area of 75 miles. The initial installation is to be of 6,000 horse power. It is believed that this will be the first of a series of great power stations to be built in the United Kingdom.

TRADE NOTES.

The Canadian Heine Boiler Company are installing a new Heine boiler in the works of the Toronto Carpet Company, King street west, Toronto.

Dick, Kerr & Co., Limited, through their Canadian office at Kingston, Ont., have just been given an order by the Lakefield Portland Cement Company, Lakefield, Ont., for one 1,000 k. w. alternating current generator and one 450 k. w. synchronous motor.

Renfrew is to have a new 200 barrel flour mill. The building is to be brick with a 50,000 bushel elevator attached. It will be a full Gyrator system and the machinery throughout will be furnished by the Goldie & McCulloch Company, of Galt, Ont. This firm we learn has much work booked in their mill building department and are very busy in all other departments.

The R. E. T. Pringle Co., Ltd., Montreal, are calling the attention of their friends and customers to the fact that they have arranged with the Pittsburgh Transformer Company to handle the sales of Pittsburg transformers in Canada. In offering this line to the trade, they point out the fact that these transformers have been very favorably known in the Dominion for reliability and efficiency. In soliciting the patronage of their friends and customers they feel confident that these will give very general satisfaction.

Mr. Geo. C. Rough, for the past six years connected with R. E. T. Pringle, has severed his connection with that company and opened offices for the Packard Electric Company, of St. Catharines, in Montreal. Mr. Rough is one of the best known electrical men in the Dominion, particularly in the eastern provinces, where he has been located for several years. Mr. Rough's offices will be located in the Street Railway Building, Corner Craig St. and Place D'Armes, Montreal. The business of the Packard Electric Company has been expanding with wonderful rapidity and the establishment of the Montreal office will doubtless facilitate a quicker handling of their business in the east. Mr. Rough's friends will wish him success in his new associations.

From the Canadian office of Dick, Kerr & Company, Limited, London, England, we have received five splendid catalogues bearing the following titles: "Continuous Current Generators"; "Rolling Stock for Electric Traction; "The English Electric Manufacturing Company, Limited;" "Electric Traction on Highways — Some Results of High Acceleration;" "Electric Traction at the Cape."

In operating oil transformers it has been noticed that the oil will occasionally follow the stranded flexible cables, due to capillary attraction and drip from the wires; this not only depletes the transformer of oil, but it is also liable to cause damage to articles, or merchandise, which may happen to be placed below such a transformer. The Pittsburgh Transformer Company has for a long time adopted a simple expedient to remedy this trouble, and it has been proven to be entirely successful. By this method the cable is cut in two just above oil level, within the transformer case, and a solid wire inserted, thus giving a portion of the cable a solid section for about one inch of its length, along which the oil can travel; this portion is then insulated by means of fibre tubing. Another improvement, which the Pittsburg Transformer Company has recently directed attention to, is the new cables with which the transformers are fitted. In this case the insulation instead of consisting of rubber is composed of a treated paper, covered with a heavy braid, and finished with a weatherproof compound. The chief feature of these cables is that they are entirely unaffected by oil, and will not deteriorate under the longest service. Their superiority to rubber covered cables is at once apparent—for it is well known that rubber coverings are very quickly destroyed by oil.

It is fairly safe to judge men by the papers for which they subscribe. Good papers attract good readers. Advertisers should bear this fact in mind. When they use high-class newspapers they should see to it that the text of their advertisements comports with the dignity and merit of the papers so used.—Printers' Ink.

DYNAMO FOR SALE.

A 20 k. w. 2000 R. P. M., S. K. C. Royal Electric Generator in good condition. Address "J. G.," Care of ELECTRICAL NEWS

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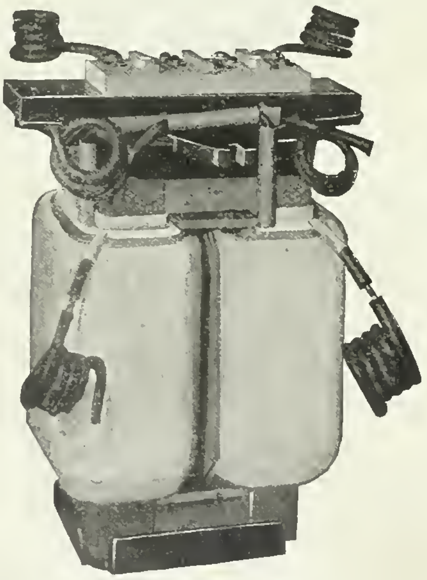

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CANADIAN
ELECTRICAL NEWS
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ENGINEERING JOURNAL

VOL. XII. DECEMBER, 1902 No. 12.

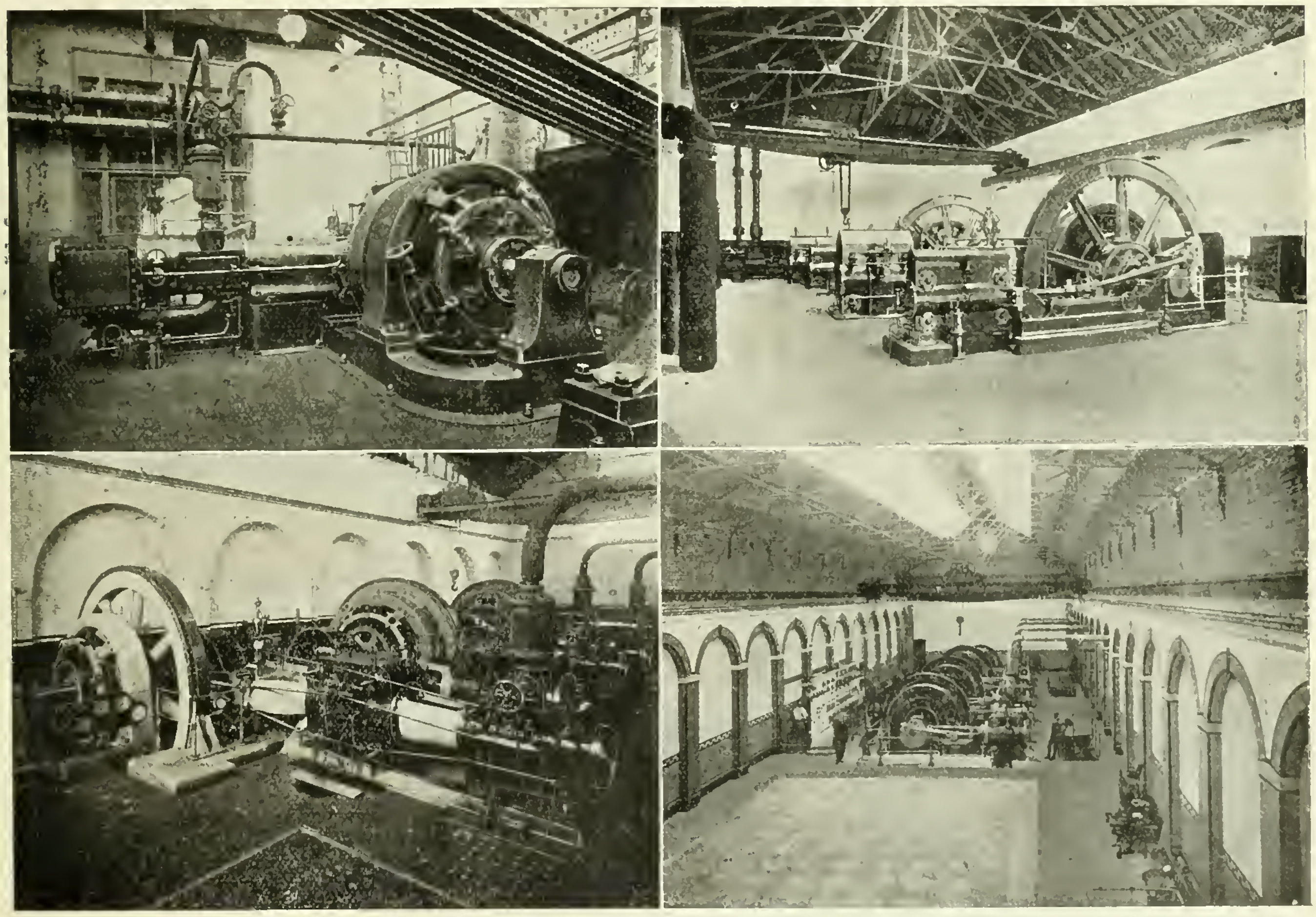
THE LONDON, AYLMER AND NORTH SHORE ELECTRIC RAILWAY.

A company has been organized to undertake the construction of the London, Aylmer and North Shore Electric Railway. This road will be a single track line about forty-five miles in length, running from London to Port Burwell, Ont., through the counties of Middlesex and Elgin. It will pass through one of the finest farming sections in Canada, and there are also numerous factories along the line. The harbor at Port Burwell being one of the finest on Lake Erie, it is expected that the road will secure a large freight business. It is proposed later to put on a line of boats between Port Burwell and Conneaut, Ohio, for coal trade.

The officers of the London, Aylmer and North Shore Electric Railway Company are: President, Mr. E. M. Luton; vice-president and treasurer, Mr. E. Lyon; secretary, Mr. C. R. Luton; assistant secretary, Mr. N. H. Stevens. The engineers are Messrs. Field & Hinchman, of Detroit, who are now engaged on the profile.

The contract for building the road has been awarded to the Aylmer Construction Company, Limited, Majestic Building, Detroit, whose purchasing agent is Mr. F. M. Hitchcock. The company is now engaged in preparing specifications, which will be completed this month, after which the work will be carried to completion as speedily as possible.

It is probable that the building of the power houses and sub-stations will be commenced early in January.



FOUR TYPICAL BRITISH PLANTS—INSTALLED BY MESSRS. DICK, KERR & COMPANY.

MANCHESTER TECHNICAL SCHOOLS.
PORTSMOUTH TRAMWAY POWER HOUSE.

PRESTON POWER HOUSE.
EAST HAM TRAMWAY POWER HOUSE.

The Rapid City Power, Light & Woollen Manufacturing Company has been incorporated at Rapid City, Man. It is proposed to develop a water power on the Little Saskatchewan river. The capital is $25,000.

TRANSMISSION PLANT OF THE OTONABEE POWER COMPANY.

The Trent Valley Canal, which, as our readers are generally aware, is designed ultimately to provide navigable water from Lake Simcoe to Lake Ontario, offers many opportunities throughout its course, especially in that section embracing part of the Otonabee river, extending from Lakefield to Peterboro, for satisfactory water power developments. It is with pleasure that we are able to record the starting of the plant of the first organization in the field, the Otonabee Power Company, which it is confidently predicted will prove to be but the forerunner of many such installations.

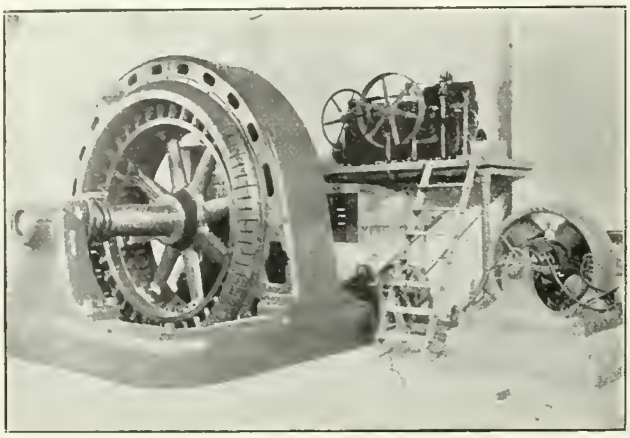


Fig. 1.—Generator, Exciter and Lombard Governor.

THE POWER HOUSE.

The power house is situated at what is known as No. 5 dam, in the Lakefield-Peterboro section of the Trent Valley system, on the west bank of the Otonabee river, about five miles directly north of the town of Peterboro. The natural conditions surrounding the site selected enabled a very cheap development, and at the same time one that it is expected will be reliable and economical to operate, in that no great difficulties are expected from frazil, the bugbear of almost all hydraulic plants situated in the colder climates.

The excavations for the wheel setting and the tail race, which were commenced a little over a year ago, necessitated the removal of all the material by blasting, the banks of the river at this point being entirely shale rock, the power house itself, as well as the wing dam extending down stream parallel with the river bank, to form the tail race, and also the concrete, being built with the stone thus obtained. In this connection it is interesting to note that the cement used, which was manufactured by the Lakefield Portland Cement Company, is produced by machines driven by the same water, their power house being situated at Young's Point, ten miles higher up the stream.

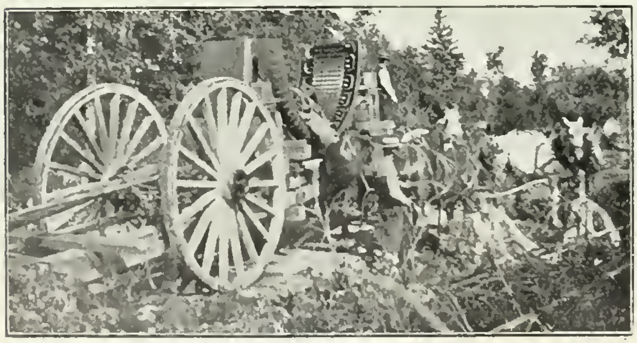


Fig. 2.—A 15-Ton Piece en route from Factory to Power House.

HYDRAULIC INSTALLATION.

The hydraulic equipment, which was manufactured and installed by the Wm. Hamilton Company, of Peterboro, consists of three 68 inch Sampson turbines, set vertically, and driving through the usual crown gear arrangement into a horizontal main shaft, to which is connected the generator. Each wheel is set in its own flume, formed by concrete walls running between and provided with means for inserting stop logs for the emptying of the wheel chambers, thus allowing for any inspection and repairs which may be found necessary. On top of these walls are set the I beams, which in turn carry cast iron bridge-trees forming the bearings and thrust collars for the horizontal and vertical shafts. The exciter is driven by its own wheel, a most commendable feature, mounted in substantially the same manner, though it is naturally much smaller, being 23 inches. The head obtained is about 13 feet, under which the main wheels running at 86 r. p. m. each develop 440 horse power. The exciter wheel, running at 255 r. p. m., is rated at 50 h. p., the speed of the horizontal shafts being changed by means of the gear ratio to 200 r. p. m. and 675 r. p. m. respectively. This head can, if necessary, be somewhat increased by means of flushboards, racks for which are provided in the crest of the dam. The equipment also includes the usual straining rack and waste gates.

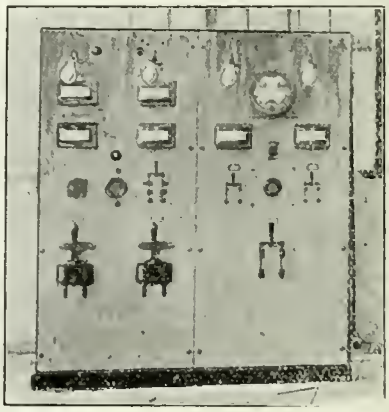


Fig. 3.—Generator Switchboard.

Above the power house extends a large sheet of still water, formed by a bend in the river, which will minimize the tendency to trouble from anchor ice. A Lombard governor, mounted as shown in Fig. 1, controls the gates of all three main wheels, the exciter being handled entirely by hand.

ELECTRICAL EQUIPMENT.

The electrical equipment of the generating station consists of one 1200 k.w., 60 cycle, 6600 volt, three-phase revolving field generator, operating at 200 revolutions, and one 30 k.w. 125 volt multipolar exciter, both direct driven, as shown in Fig. 1, and controlled by a switchboard of the usual type, equipped with the necessary volt, ampere and watt meters and oil break switches, the front view being shown in Fig. 3. The voltage chosen was selected as being high enough to allow the use of line copper of a reasonable size while still being within the limits of potentials which it is possible to generate directly in the alternator and thus eliminate the necessity for step-up transformers. Besides it has the further advantage of being the same as that of the Canadian General Electric Company's Nassau station, and thus permits the convenient interchange of power should it ever be found desirable. All the wiring between the machines and the board is carried under the floor, lead covered cable in iron conduits being used.

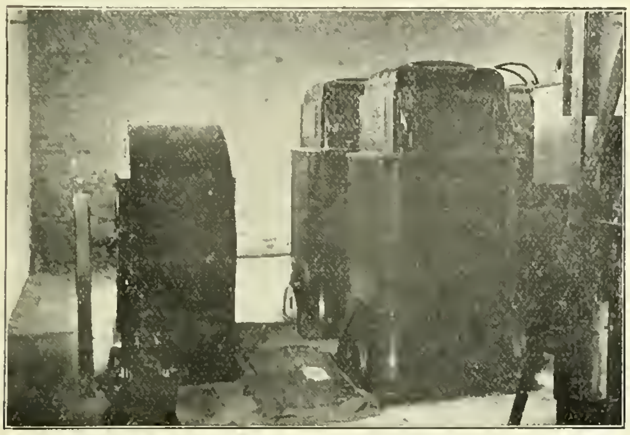


Fig. 4.—Transformers in Sub-Station.

From the switchboard to the lines it runs in the open up the face of the wall. The lightning arresters, each of which is provided with a cut-off switch for cleaning and inspection, are also mounted on this wall, being connected to the lines at the point where they enter the building. Ordinary heavy porcelain tubes are used for this latter work, the wire being heavily rubber covered to a point distant some few feet from the outside walls, where they join the bare line wire. The power house is designed to accommodate another machine, which it is confidently expected will soon be required. Accommodation is also provided for a crane which is not yet installed. The electrical apparatus was furnished and installed by the Canadian General Electric Company.

THE POLE LINE.

The line, which consists of two circuits, mounted on one set of poles, leaves the power house on the north, and immediately turns east to cross the river, from whence it goes generally south along the right of way of the Lakefield branch of the Grand Trunk Railway, a most suitable and convenient route, free as it naturally is from anything but very small grades, and affording, through the medium of a hand car, means for quick and easy patrol. Each circuit consists of three No. 2 copper wires mounted on No. 2 Imperial porcelain insulators, spaced equilaterally, the base on top, a somewhat unusual arrangement, and protected in addition to the lightning arresters at each end, by a barb wire strung on top pins and standard glass insulators, and grounded at every fifth pole to an iron plate placed under the butt.

These power circuits are not transposed, modern practice not requiring it unless in the case of long lines of high capacity whose load consists largely of lighting, and where very close voltage regulation is necessary.

Underneath the main circuits, mounted on the standard pins and cross arms, are the two telephone lines, of No. 10 iron wire, which connect the power house, sub-station, office and manager's residence. They are transposed every five poles to prevent disturbance from the power lines overhead. The method of entrance into the substation is identical with that adopted for the exit from the power house, the wiring until it reaches the switchboards all being overhead. A similar lightning arrester equipment is also installed here.

THE SUB-STATION.

The sub-station, which is of brick, 22 x 35 feet, is situated on the river bank at the corner of Simcoe and Water streets, about in the centre of the town of Peterboro, and approximately equidistant from the various factories which it will supply with power. The equipment consists of transformer and feeder switchboards and six 250 k.w. air blast transformers of the standard Canadian General Electric type, supplied with the necessary cooling air by means of a fan driven by a two h.p. induction motor. The general arrangement of the blower and motor and part of the transformers can be seen from Figure 4, from which it will be noted that, differing from the usual arrangement of air blast transformers, whereby they are mounted on a raised platform to form the necessary air chamber, this latter is obtained by means of excavating under the floor level, which, besides improving the appearance of the room, makes it much easier to install the apparatus.

The chamber under the transformers is about 18x12 and 4½ feet deep, a convenient size for inspection and cleaning, a trap door being provided for entrance. This chamber, besides carrying the air from the blower to the various transformers, serves also for the wiring, which is run in conduits from the switchboard to the underside of the transformers, up through the air opening to the low potential connection board, which is on the bottom, and through a pipe, shown in Fig. 4, to the high potential connections, which are on the top of the transformers.

The switchboard, equipped with the standard set of instruments which is usually provided for work of this class, controls the transformers, the two incoming lines and the outgoing feeders, making various combinations between them, by means of oil break switches. The only special feature is the use of switches which enable any transformer to be instantly cut in or cut out of service, the changes being made without interruption to any part of the system.

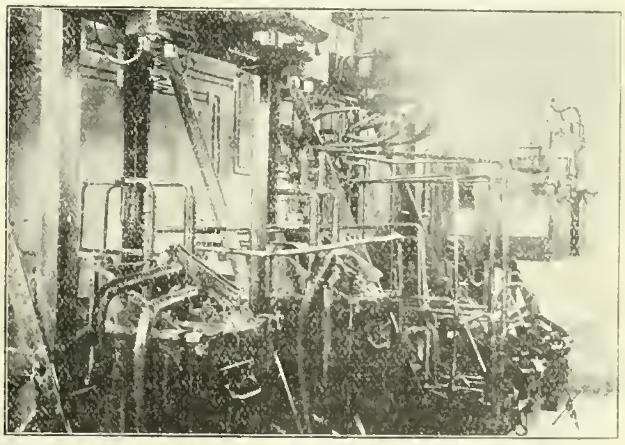


Fig. 5.—Rear of Switchboard, Showing Connections of Oil Brake Switches in Sub-Station.

The principal consumers of the power generated by the Otonabee Power Company will be the Cordage Company, which has already installed some four hundred horse power in motors, the Wm. Hamilton Company, the Matthews Packing Company, the Ultemator Sifter Company in Ashburnham, just across the river, the Hicks Mfg. Company, W. H. Meldrum's elevator and the Colonial Typewriter Company. Doubtless the present plant will soon be loaded to its full capacity, as the town of Peterborough, which is to be congratulated on its list of manufacturers, both existing and prospective, is growing very rapidly and well maintaining its position as one of the premier towns of Canada.

The officers of the company are: Wm. Ferguson, manager Kingston Hardware Company, president; W. A. Stratton, solicitor, first vice-president; Adam Hall, president of the Canadian Cordage Company, 2nd vice-president; R. R. Hall, treasurer; W. H. Meldrum, managing director. The harnessing of this magnificent water power has been carried out under the direction and personal supervision of Mr. Meldrum, who may feel justly proud of the successful installation of this splendid plant, all his efforts being fully sustained by every member of the directorate.

As advised above, the entire work was carried out by local contractors, the hydraulic installation by the Wm. Hamilton Company and the electrical installation by the Canadian General Electric Company. The buildings were designed by Mr. John E. Belcher.

INSULATORS FOR LONG DISTANCE POWER TRANSMISSION.

The following abstract relating to insulators for electric power transmission lines is taken from an interesting paper on the problems and difficulties of the transmission of power long distances, read by Dr. F. A. C. Perrine before the Massachusetts Institute of Technology and printed in the "Technology Quarterly."

For potentials up to about 25,000 volts, where an insulator of 7-inch diameter is sufficient, there seems not much reason for the employment of anything except glass, unless the lines reach a size above half an inch in diameter, when its strength is deficient. For these lower potentials and lighter lines the good properties of glass are easily summarized. In the first place, it is cheaper by far; while not so strong as porcelain, it is, as has already been said, sufficiently strong for the purpose; its inspection is easier and surer, since it requires only a visual examination and a few taps of a hammer to acertain its soundness in place of the tedious high potential test necessary in the examination of porcelain. But having said this much, all has been said that is possible in favor of glass.

It is not true that glass is a better insulator than sound porcelain, nor is its surface so good in damp weather against surface leakage. The mechanical strength does not equal one-half that of porcelain, as has been proved by a long series of mechanical tests performed by dropping a steel ball from a height upon insulators of the two materials; temperature also affects it much more than porcelain and it is often found to crack simply from the effect of extreme changes of temperature.

The insulators for high voltage lines must be very large, for the reason that with a striking distance through the air of from 4 to 6 inches, great gaps must be provided in the path of the current. But above all a great creeping distance is essential. Insulators that are a perfect protection in the hardest rains fail utterly in clear weather when covered by smoke and soot, which allow small amounts of currents to escape and char away the pins or cross-arms. The compound insulator is very attractive, for the reason that it is easier and cheaper to make and handle two or three small parts rather than one large one, and in some cases the additional advantage has been sought of securing the good properties of both glass and porcelain by making parts of an insulator of each; but there is both a theoretical and practical fallacy in this type of design. In the first place, no dielectric is so strong as one entirely homogeneous. As the stress is passed from glass to porcelain, or vice versa, at the two surfaces the stress piles up as it were, and it is better if one believes in glass to rely upon it; or, on the other hand, to show faith in the porcelain used by employing it entirely.

From the pure standpoint of practice the insulator which must be cemented together is troublesome. The shrinking of the mastic leaves voids and produces strains; if cement be used, its slowness in hardening delays the work and requires large areas for setting out to harden any considerable number of insulators. The one other mastic in use is molten sulphur, which, while better as a mastic than cement, is still more liable to crack the insulators while they are being joined, and finally when exposed to light and air, frequently decomposes on the surface, producing sulphuric acid; and, finally, when current creeps over its surface following the acid, perhaps cathes fire and often results in the rupture and fall of the insulator. The insulator which will be entirely satisfactory for this use has not yet been found, but the diligent search made for it by some of our best engineers is resulting in its definition and will probably soon result in its production, not as an inspiration for a patent, but as a careful engineering conception.

THE CURRENT REQUIRED BY ELECTRIC MOTORS.

A recent number of Science and Industry, published at Scranton, Pa., contains as a supplement a table showing the current taken, at full load, by various sizes of electric motors of both direct and alternating current types, at the ordinary pressures of 110, 220 and 500 volts.

The ampere consumption of direct current motors depends directly upon the efficiency of the motor, and with alternating current motors it depends upon both the efficiency and the power factor of the motor. These qualities vary somewhat in motors of different make, so the values given in the table herewith may be considered as fair, rather than exact, averages. They are useful in making wiring calculations, fusing, etc. The current given for two-phase motors is the full load current of each phase; the current for the three-phase motors is the current in each of the three wires leading to the motor.

H. P.	Direct Current Motors			Alternating Current Motors.								
	110 v.	220 v.	500 v.	Single-Phase			Two-Phase (4 Wire)			Three-Phase (3 Wire)		
				110 v.	220 v.	500 v.	110 v.	220 v.	500 v.	110 v	220 v.	500v.
1	9	4.5	2.0	14	7	3.1	6.4	3.2	1.4	7.4	3.7	1.6
2	17	8.5	3.7	24	12	5.3	11	5.7	2.5	13	6.6	2.9
3	26	13	5.6	34	17	7.5	16	8.1	3.5	19	9.3	4.1
5	40	20	8.8	52	26	11	26	13	5.5	30	15	6.4
7½	60	30	13	74	37	16	38	19	8.1	44	22	9.3
10	76	38	17	94	47	21	44	22	10	50	25	12
15	112	56	25				66	33	15	76	38	17
20	150	75	33				88	44	19	102	51	22
30	226	113	50				134	67	29	154	77	33
40	302	151	66				178	89	39	204	107	45
50	368	184	81				204	102	45	236	118	52
75	552	276	122				308	154	68	356	178	77
100	736	368	162				408	204	90	472	236	104
150	1110	555	244				616	308	135	710	355	156
200	1474	737	324				818	409	180	940	470	208

THE SLEEPER PATENT STEAM ENGINE.

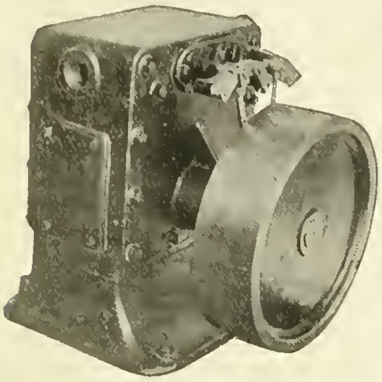


FIG. 1.—EXTERIOR VIEW OF 12 B.H.P. SIMPLE, SINGLE-ACTING ENGINE.

A steam engine with many new and, one might almost say, many revolutionary features has recently been placed upon the market by the Sleeper Engine Company Limited, of Montreal. It is in its entirety a Canadian invention, and since the first patent was applied for, now some two years since, it has been financed and backed by Canadian capital. As might be inferred, it takes its name from the inventor, Mr. Frank H. Sleeper, formerly of Coaticooke, but for many years a resident of Montreal. Mr. Sleeper is well known for his inventions in special and electrical machinery and wire machines, as also for the lifting jacks which are now in universal use on this continent, and his many friends will be glad to know that the success which has attended so many of his inventions in the past—a success which has been due as much to a correct appreciation of machanical principles as to boldness and originality of design,—has followed also in the case of the Sleeper steam engine.

Considered either externally or internally, these engines present an altogether different appearance to the ordinary reciprocating engine. Externally, there is no extended frame with massive base and heavy bearings, nor does it show the familiar cylinder, piston, slides and crosshead. Instead, there is seen a circular or rectangular cast-iron casing, in which all of the working parts are enclosed. Its first advantage, that of exceeding smallness and compactness, is thus disclosed. This elimination of metal and size has not in any way, so far as can be ascertained, impaired its strength, wearing power, or its ability to "stand up" under a heavy load.

Coming now to a consideration of the internal arrangement, or rather, to the actual working parts, it will be clearly seen from the illustrations that the old cylinder-and-piston form of design has been abandoned, and that the expansion chamber is composed of a flexible wall, made up of two parts connected by a link. The hinges of the parts of this flexible wall are provided throughout with roller bearings. The flexible wall is attached to the crank-shaft by a connecting rod, and the outward movement of the wall, when steam is admitted to the chamber, actuates the crank-shaft.

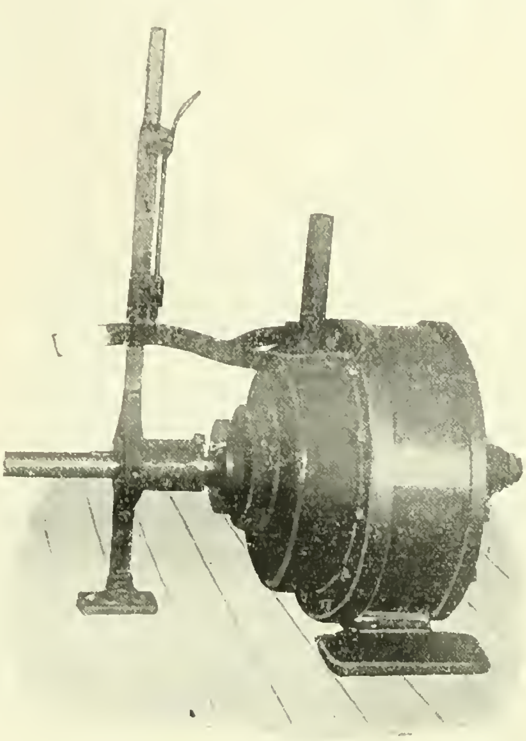


FIG. 2.— EXTERIOR VIEW OF 5 H. P. MARINE ENGINE.

In the last analysis, when one is really forced to make a definition, the Sleeper engine cannot be said to be any other than a reciprocating engine, though several mechanical experts have called it a semi-rotary engine. This makes it a very difficult matter, when dealing descriptively with an engine of this kind, to institute comparisons, since it is in a class by itself, being a connecting link, as it were, between the reciprocating and the rotary engines. From the design it will be seen that that form of construction which has figured so much in rotary engines, namely, an internal cylinder revolving eccentrically within another cylinder, or carrying sliding, projecting wings in contact with the internal wall of the outer cylinder, has been altogether avoided. What has really happened in a manner is that the enormous side-thrust which was the defect in these machines has been practically utilized to drive the Sleeper engine. The great leakage which put so many of these engines out of the range of practical usefulness has been reduced in the Sleeper engine to a factor of little importance. It is conceded that it has been these two factors, i. e., friction of internal parts which could not be obviated, and leakage of steam by and between surfaces which it was impossible to pack steamtight, which has hitherto kept engines designed for very high speeds, with great compactness of size and weight, out of the market.

In the engines of the circular type, used for high-speed, direct-connected electric lighting and marine work, connecting rods are not used to connect the flexible wall of the expansion chamber and the crank-shaft. Instead, a crank eccentric is provided, and upon it the flexible walls bear by means of rollers one after the other, as steam is admitted to the chambers consecutively.

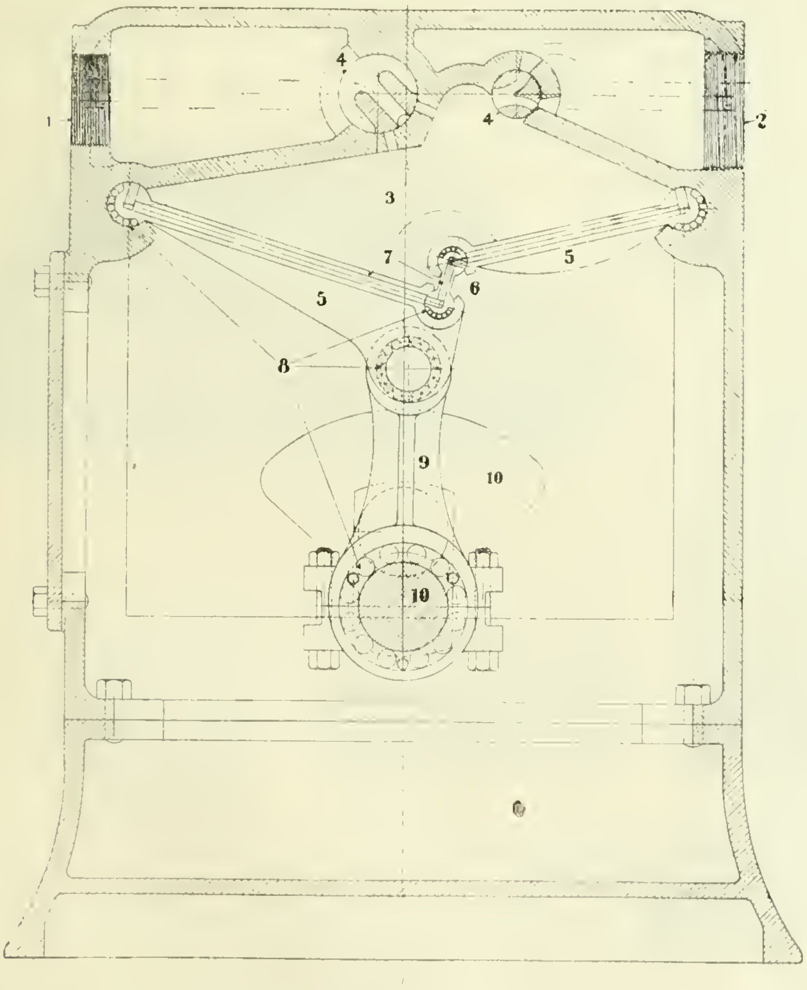


FIG. 3.— SECTIONAL ELEVATION OF SIMPLE, SINGLE ACTING ENGINE ON BASE.

1. Steam inlet. 2. Exhaust outlet. 3. Expansion chamber. 4 and 4. Valves. 5 and 5 Parts of flexible wall of chamber. 6. Link connecting parts. 7. Packing strips. 8. Roller bearings. 9. Connecting-rod. 10. Crankshaft.

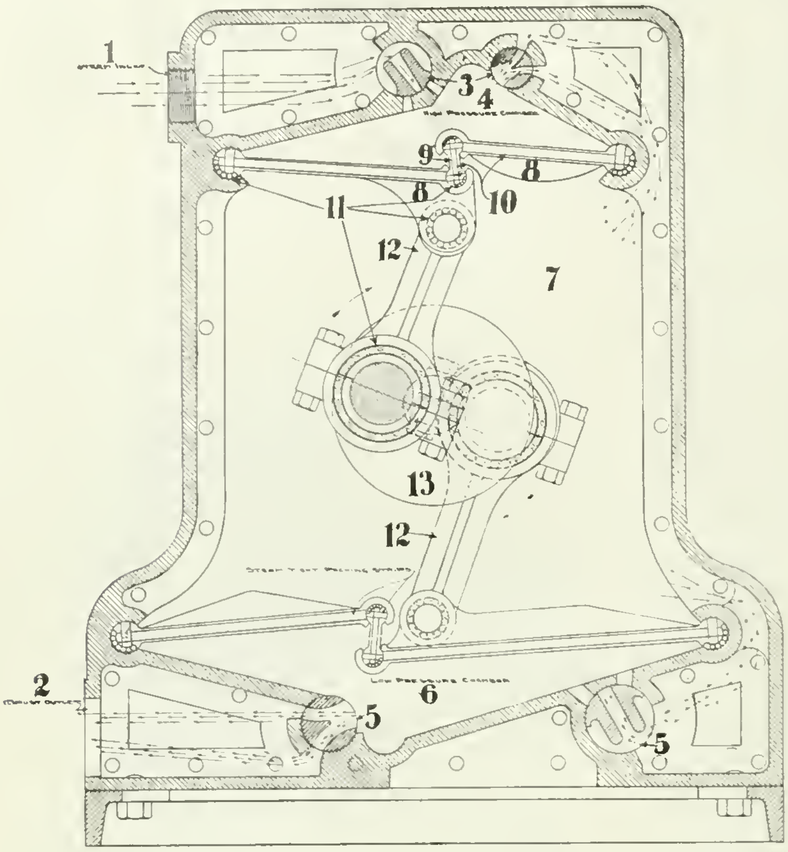


Fig. 4.—Sectional Elevation of 25 h.p. Compound Engine.

1. Steam inlet into high pressure chamber. 2. Exhaust from low pressure chamber. 3. Inlet and exhaust valves for high pressure chamber. 4. High pressure chamber. 5. Inlet and exhaust valves for low pressure chamber. 6 Low pressure chamber. 7. Engine body used for steam reservoir. 8. Parts of flexible wall for bigh pressure chamber. 9. Link connecting parts. 10. Steam tight packing strips. 11. Roller bearings. 12. Connecting rods. 13. Crankshaft.

On the stationary engines of the rectangular type, valves of the Corliss variety are used, with a modification as to the valve gear. On the other hand, a valve of an entirely new design is used on the engines of the circular type. This may be studied in Fig. 6. It is a balanced slide-valve, operated by an eccentric upon the shaft, and guided in straight lines across the steam inlet port openings by an arrangement of elliptical ring and links.

A close study of the sectional elevations and interior views shown in Figs. 3, 4 and 5 will show the great care that has been taken with regard to the bearings of these engines. In all cases the pins, shafts, and other rotative parts, the rollers themselves, and the outer sleeves or shells in which the bearing cages revolve, are of steel, hardened and ground. The cages are of an advanced design which has for its primary object the ensuring of an absolute parallelism between the shaft and rollers, preventing effectually the binding and twisting tendencies which nullify the use of many roller bearings.

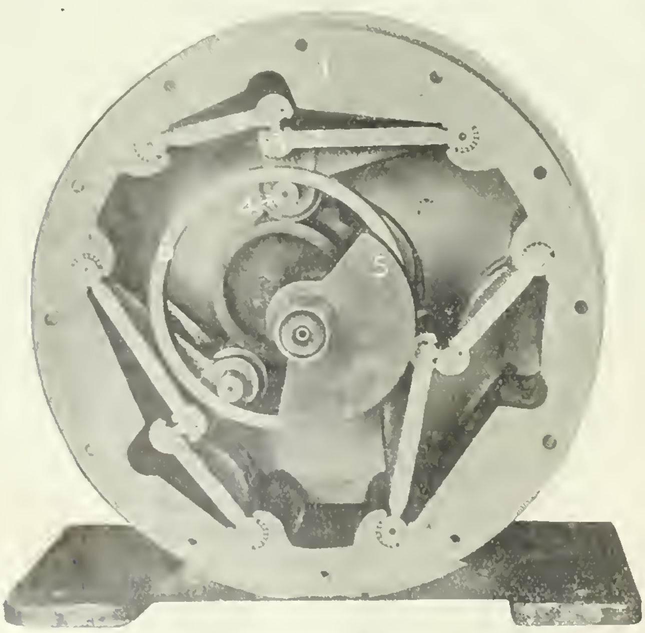


Fig. 5.—Interior View of Marine Engine.

1. Frame. 2. Parts of the flexible wall of expansion chamber. 3. Link connecting parts. 4. Roller bearings on crank eccentric. 5. Crank eccentric. 6. Retaining ring.

Leakage of steam from the chambers is prevented by a system of packing strips which take up wear automatically, and require no attention or care whatever.

Some of the most interesting features about the Sleeper engines, and those to which the manufacturers direct attention especially, after the expansion chamber and the valve motions and gear, is the reversing gear on the marine and automobile engines. It is operated with one movement of the reversing lever, without special gearing, and is instantaneous. Another feature is the absence of vibration, "knocking," "slack," and the inertia movement in starting and stopping. Again, by the structure of these engines they are specially adapted for use with superheated steam at high pressures, being in accordance with the most advanced steam-engineering practice. But the features which the manufacturers lay even greater stress upon, and to which they are now directing the attention of the engineering profession, are of much more importance than even these. We refer to the steam economy which several series of tests in McGill University Laboratory has distinctly proven to be very great, and to the very high speeds attained by all types of these engines.

The tests were made upon simple and compound engines of the type shown in Fig. 1, and further illustrated by sectional views in Figs. 3 and 4, and collected into brief form are as follows :

TESTS OF 12 B. H. P. SIMPLE, SINGLE-ACTING ENGINE.

Trial No.	Brake H. P.	R. P. M.	Steam used per B.H.P. per hr.	Steam Pressure.	Load.	Brit. T. Units per B.H.P.
1	5.63	650	56.5 lbs.	44	1/3	905
2	10.2	707	40.4 "	53	2/3	647
3	13.1	726	36.4 "	84	Full.	590

The report further states : "Variations in speed between 650 R. P. M. and 725 R. P. M. made very little difference in the economy." And again : "This is an exceptionally good result for a single-acting engine, and I believe it has never been equalled by any single-cylinder engine of this small size."

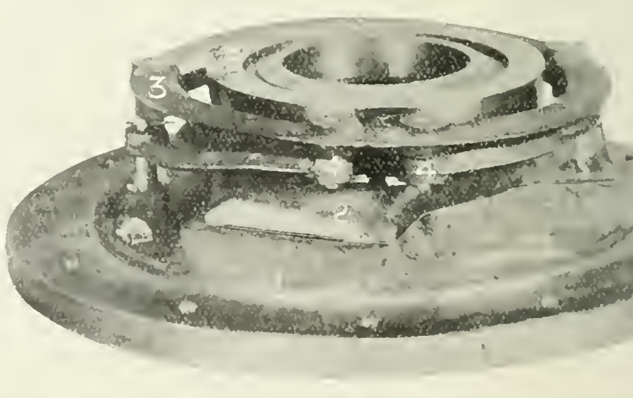


Fig. 6.—Valve Motion.

1. Valve seat. 2. Valve. 3. Elliptic parallel ring. 4. Links. 5. Relief ring.

In this view the valve motion is shown detached from the engine body. The line of contact between the seat and valve may be plainly seen. The motion imparted to the valve by the eccentric is circular, and the ring and links are used to change or guide it into such a motion that the valve moves across the port opening in straight lines. The parallel ring being elliptic the valve is free to move inside of it in one direction, guided by links fastened at one end to the valve and at the other to the ring. Both ring and valve will also move together at right angles to the first direction, this movement being also guided by other links fastened at one end to the seat, and at the other to the ring. The manner of securing links may be plainly seen.

It was a natural expectation that if such remarkable economy was attained by a simple engine, much greater efficiency would be attained by engines of the compound order. How far this expectation has been met by the results obtained may be judged from the figures following, taken in advance from an official report of the McGill University Laboratory.

TESTS OF 25 B. H. P. COMPOUND, DOUBLE-ACTING ENGINE.

Steam Pressure Gauge.	Load B.H.P.	Steam Consumed per B.H.P. per hour.	Vacuum equal to
106 lbs.	23	25.3 lbs.	24.6 inches of mercury.
62 lbs.	14	28.6 lbs.	22.5 inches of mercury.

The following are selected from among a number of private trials made by Mr. Frank H. Sleeper:

25 B. H. P. COMPOUND ENGINE.

Trial No.	Steam H.P.	Steam Int.	Vacuum.	Cut-off H.P.	Cut-off L.P.	R.P.M.	Load B.H.P.	Steam used per B H.P. per hour.
1	52 lbs.	5 lbs.	22 in.	—	—	714	16.4	26.5 lbs.
8	85 lbs.	12½ lbs.	22 in.	⅝	¾	600	25.25	26.75 lbs.
9	———	———	22 in.	⅝	¾	333	12.75	26. lbs.

A curious and yet important feature of these engines, which is shown by such tests as the above, is that very little difference is made in the efficiency whether running at half or full speed.

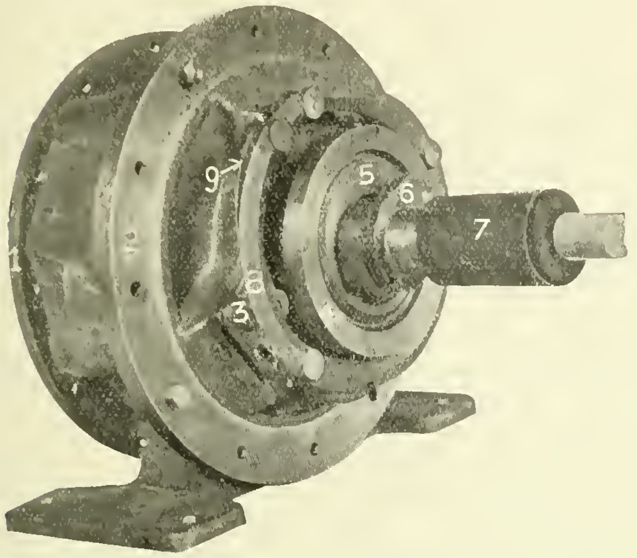


Fig. 7.—Marine Engine, with Steam-Chest Cover Removed, Showing Valve Motion, with Lower Left-Hand Steam-Port Open.

1. Engine frame. 2. Valve seat. 3 Valve. 4. Relief ring. 5. Eccentric. 6. Inner reversing sleeve. 7. Outer reversing sleeve.

Despite the very high speeds at which the compound engine referred to was run, the Professor in charge of the Laboratory managed by means of an ingenious arrangement to take off some indicator cards, and some of these we hope very soon to present to the readers of the Electrical News. We will inform them in advance that the cards have an ideal form, and accord so closely to the perfect card that there is apparently no leakage whatever in the engine.

With reference to the other point, i.e., that of high speed, there is much more in it than is usually thought, and this is a point which such a discussion as the foregoing brings up clearly.

One of the principal losses in a steam engine is that due to condensation on the cylinder walls. In the best engines such a loss may be only 25 per cent., while in the worst types it may be as much as 70 per cent. By practical experiment it has been found that increasing the speed of the engine has the effect of decreasing this loss. In an engine running at 400 r. p. m. the loss is but one-quarter of that in one running at 120 r.p.m. Consequently, leaving friction aside, the higher the speed the greater the economy, and at 1000 r. p. m. the loss from this cause would be nil. The leakage of steam past valve and piston is another and serious loss which is minimized by high speeds. Let us suppose, for example, that an engine rnnning at 100 r.p.m. leaks steam in this way to the extent of 50 per cent. of its useful supply. Now, let the speed be increased to 1000 r. p. m., while the steam pressure remains the same. It will be seen at once that the leakage per hour has not been increased, while the power has been increased tenfold, reducing the leakage from 50 to 5 per cent.

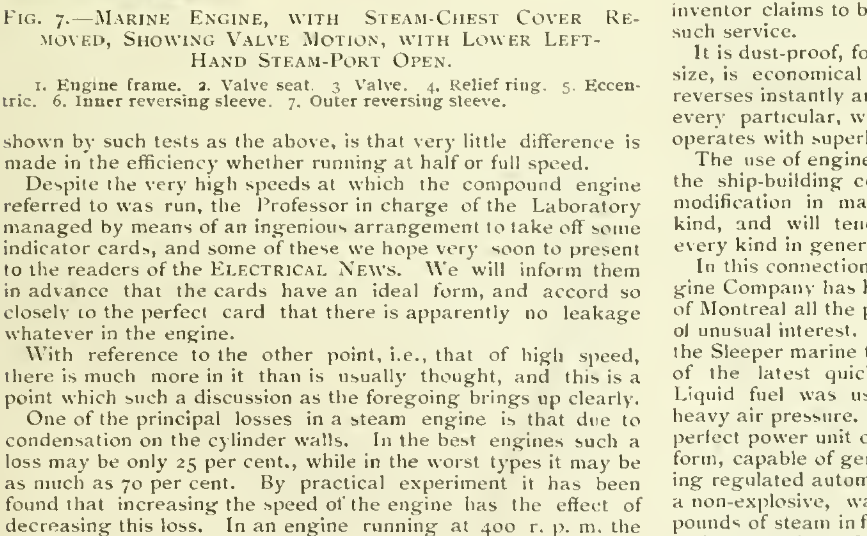


Fig. 8.—Roller Bearings.

1. Pin or shaft. 2. Cage for rollers. 3. Rollers. 4. Outer sleeve.

The secret of the high efficiency of the Sleeper engine is claimed by the inventor to lie in the reduction of friction and weight of the working parts to such an extent as to permit of very high speeds being attained without danger, as is evidenced by the lack of noise and vibration, lessening leakages and condensations, and tending constantly to greater and greater efficiency.

The working parts, besides being in mechanical balance, are, by comparison, very small and light; this materially assists in the diminishing of noise and vibration. Even when running as high as 2500 r.p.m. stability is a marked feature of these engines. On engines of the circular type, a flywheel is unnecessary. These engines are used for marine and automobile service. The weights of the frame and moving parts are well distributed and all bearing surfaces are generously proportioned.

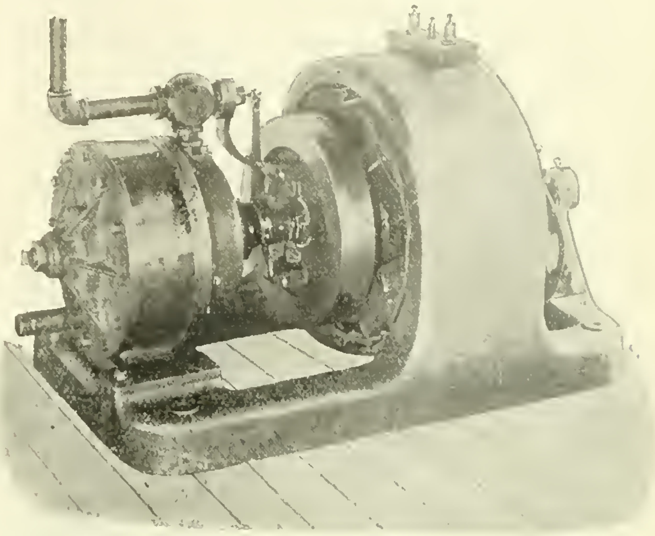


Fig. 9.—3½ Kilowatt, Direct Current, Multipolar, Sleeper Generator, Direct-Connected to Throttle-Governed Sleeper Engine on Same Base. R.P. M. 1000. Base Dimensions, 18 in. x 31 in. Weight, Complete, 600 Pounds.

Referring especially to automobile work, an engine which the inventor claims to be perfect has been designed especially for such service.

It is dust-proof, fool-proof, weighs but fifty pounds in a 6 h.p. size, is economical of steam, simply and perfectly lubricated, reverses instantly and without special gearing, of rapid control in every particular, without vibration and without flywheel, and operates with superheated steam at high pressures.

The use of engines of the Sleeper type generally throughout the ship-building countries will be certain in the end to effect modification in marine architecture of the most far-reaching kind, and will tend in many ways to important economies of every kind in general cost and maintenance.

In this connection it is interesting to know that the Sleeper Engine Company has had an exhibition steam-launch in the vicinity of Montreal all the past season, operating under circumstances of unusual interest. The combination consisted of an engine of the Sleeper marine type, connected to an automobile coil boiler, of the latest quick-steaming, semi-flash, non-explosive kind. Liquid fuel was used, it being forced into the vaporizer under a heavy air pressure. Here we have the three requisites for the perfect power unit of the future—i.e., fuel in a cheap, convenient form, capable of generating intense heat very quickly and of being regulated automatically by the steam pressure in the boiler; a non-explosive, water-tube boiler capable of generating 250 pounds of steam in five minutes, light, compact, safe, and reliable; and an engine of exceptional steam economy, running at very high speeds, reversing instantly, and without noise or vibration.

The high speeds which make these engines so valuable in other lines will be seen at once to be of incalculable value in electrical work, and the service rendered so far has been unmistakably towards a still greater economy in electric lighting and general power. The high speeds enable one to take advantage of the greater efficiency of generators when run fast, and enables at the very least double the power to be laid down in the same station plant space as compared with slow speed units, while the parts are not nearly so cumbersome and massive, and may be much more readily handled and moved about the station. The great reductions effected in the size and weight of the engines themselves places them at a great advantage in one respect, i. e., that unlike all other units, in which the generator may be said to be placed upon an extension of the engine base, with the Sleeper engine, and that too despite the much higher speeds—the positions are reversed, and the engine is placed upon an extension of the generator base. Nothing else will give such a vivid idea of the compactness and small-floor-space dimensions of hese engines. In operation the direct connected units are auotmatic, the valve being set at the most economical point of cut-off, and the engine being throttle-governed. With such an automatic control the lights are free from fluctuation, the speed being positively maintained.

G. D. Hartley.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Chambly Plant. A newspaper dispatch of November 30th conveyed the information that a portion of the dam of the Chambly Manufacturing Company at Chambly, Quebec, had on that day been carried away. It is understood to be the intention to build a new coffer-dam, which will probably be completed within a month. Since its inauguration, less than five years ago, this plant has been particularly unfortunate. This is the second time that the dam has broken away; the original water wheels have been replaced by others of different type; the generators have been rewound; and material changes have been made in the switchboard. In the construction of the plant engineering advice of a high standard was secured, but notwithstanding this and other precautions the changes to which we refer were found advisable. These circumstances indicate that as a rule water power is not as reliable as steam.

Canada's Development. CANADA has entered on a period of development which seems likely to rival that of the United States. Almost every day brings news of some colossal enterprise, and we are becoming so accustomed to such announcements that as a rule we receive them with but very moderate surprise. The declaration however by the authorities of the Grand Trunk Railway Company of their purpose to begin immediately the construction of a line by way of the Peace River Valley to the Pacific Coast, has naturally awakened the deepest interest from one end of the country to the other. The announcement is a declaration of confidence in the future of our great northwest territory that must greatly redound to the benefit of this country. The expenditure of something like $100,000,000 in the construction of the new transcontinental line will help to extend and maintain for some time to come the prosperous conditions which now prevail, while the inflow of population following the opening up of a vast and fertile territory, will permanently broaden the market for manufactured products. The future greatness of Canada seems now to be assured and considering the rapid movement of events in these days, another decade will probably witness its realization.

The Recent Street Railway Convention. THE amenities of modern business life and relaxation from its strict routine and discipline are few and far between. It was therefore with great pleasure that we were able to publish last month the names of most of our larger street railway companies as among the number of those who saw fit to give various of their departmental heads the opportunity which was afforded by the recent Detroit meeting of the American Street Railway Association to meet those who have duties and responsibilities much the same as their own, and to inspect and become more or less familiar with the latest developments and specialties in modern electric railway practice. No man who is for ever confined to the routine and methods of his own particular company can be expected to produce results as good as he might be capable of were he given the opportunity to rub against other men and their ideas. We look for great benefits from the visits of the various delegates—not only from the introduction of new apparatus or methods which those concerned may decide to be beneficial to their respective companies, but also from the closer and more permanent relations induced between the companies and their employees; it is to be hoped that the example which has been set will be followed to an increasing extent each year. By the way, it was an open secret during the progress of the meeting that difficulty was being experienced in selecting a meeting place for next year, in view of which an invitation from Toronto would doubtless be acceptable. No one can doubt but that if the convention were to come here the benefit derived therefrom would be large, not only by the city itself but also by the country at large.

Fire Risks.

A correspondent forwards to the Insurance and Finance Chronicle, Montreal, the following extract from an insurance book published in 1895:

> "Friction of machinery is one of the most common causes of fire, especially at night. The shaft heats from the centre, and the heat may increase and spread after the machinery has stopped."

The correspondent states that while fully agreeing with the first part of the above statement he is skeptical as to the latter, and asks for proof or disproof thereof. As it does not seem meet that apparently erroneous statements, which concern apparatus handled by a large portion of our subscribers, should go uncorrected, we would state what we consider the correct view of the case. The heating of a shaft does not take place from the centre, but from the outside, the point where the friction against the bearing, which is the source of the heat, exists, though the centre may get hotter, ultimately, than the outside. If, when matters were in this condition, both as regards the bearing as well as the shaft, the machinery were stopped, the radiation will be much less because the surrounding air is now still, consequently the heat stored up in the interior may by convection increase the heat of the exterior to a point above that at which it was when in motion, but neither the total heat, nor the temperature of the hottest part, can possibly increase after the apparatus has been brought to rest, and therefore the source of the heat, namely, the friction of the journal against its bearings, is entirely eliminated. The case is similar to that of a motor or dynamo, in which the heat of certain parts, such as the ends of the windings outside the poles, the outside surface of the armature and commutator connections, may rise materially as soon as shut down, due to the fact of the radiation being greatly reduced because it is not now moving rapidly through the air; the heat from the inside of the windings and commutator bars tends to spread and equalize through all parts, though both the total heat and the temperature of the hottest part begin to fall the instant the apparatus is shut down, and thus the flow of current and magnetism, the sources of the heat, are stopped.

A Large Switchboard.

THE Clergue power plant on the American side of the Soo, which was opened with much eclat not long ago, though second only to Niagara in its total capacity, which is about 45,000 horse power, possesses no very special features in the lay-out of the generators, which, 80 in number, part Westinghouse and part Stanley, are all of the revolving field type, and rated at 400 k.w. each, though when we come to look over the switchboard controlling it we find many new and most interesting devices. In the first place, there had to be faced the problem of arranging a board which would be practicable as far as length was concerned, as if made according to standard practice it would have extended to nearly 300 feet, and so it was finally decided that it should be built in three sections arranged so as to form three sides of a 12 foot square, these small dimensions being rendered possible by making each generator panel but six inches wide, and by mounting above them those for the feeders, which are half as many in number. The control of all the different parts of the equipment is that known as the pilot system, whereby none of the main circuits are themselves brought to the board, which consequently contains only shunt-circuit instruments and small switches for controlling the relays which operate through solenoids the main switches. Any failure of the energizing current in these relays results in the instantaneous opening of all those main switches which it controls, this action being similar to the safety principle of the block system of signals for railways, where any interruption either from a short or open circuit immediately sets all the semaphores to danger. This controlling equipment comprises not only that necessary for the handling of the generators and feeders, but also for that of the wheels, which can be started and stopped, speeded up or slowed down, by means of switches provided on the generator panels. In this connection it is interesting to note that the water-wheel governors, which are of the Lombard type, instead of being equipped each with its own pump, as is the usual practice, are supplied on what might be called the central energy system from one common pressure reservoir. Owing to the narrowness of the panels the generator meters are all very close together, and naturally being at the same level, their needles, when all are carrying their proper share of the load, form almost a straight line round the board. Any variation from normal, as indicated by some one pointer being out of the line, is therefore at once noticeable, and the work of correcting the difficulty which it indicates, owing to the control of the wheels as well as of the generators being on the same panel, takes practically no time. In addition to the above special features the board possesses the usual equipment of double bus-bars, switch indicating lamps, bus-bar coupling switches, etc., and will doubtless give a good account of itself in the somewhat difficult task which it has before it.

ELECTRICAL MACHINERY.

Orders have been placed by the authorities of Queen's College, Kingston, with seven or eight Canadian firms for some very intricate electrical equipment for the new Engineering Building. In the study of electrical and mechanical engineering, a great many generators, transmitters, various kinds of batteries, and motors are needed, and especially some very fine electrical devices for cutting and separating minerals and for separating various kinds of ores. The college authorities have spent over $5,000 in electrical equipment and were able to get almost everything they wanted from Canadian firms. The machinery ordered is now arriving and will at once be placed in position under the supervision of Prof. Dupuis, dean of the Faculty of Science, and Prof. L. W. Gill, B.Sc., who has charge of the subjects of mechanical and electrical engineering. The growing importance of this new department of Queen's, for the erection of which the Ontario Government voted $35,000, may be partially understood when it is stated that there are at least fifty per cent. more students taking electrical engineering now than there were in the 1901-2 session.

QUESTIONS AND ANSWERS

"J. M.": What certificate is required of the men in charge of electric light plants?

Ans.—None at all as far as the electric machinery is concerned, but if it be driven by steam power it must be operated by a man who has the necessary certificates as a steam engineer; if driven by water power none are neccessary.

"Station Superintendent": Should the ammeters of my two generators be connected in the positive, negative or equalizer leads? Does it make any difference where the series coils are put, in the positive or negative sides?

Ans.—The series coils may be connected into either the positive or negative leads, as may be most convenient; and the ammeters must be connected into the lead of opposite polarity to that in which you put the series coils. If they are put in the same side they will not register that current which may be passing through the equalizer and the series field of the other generator. If inserted in the equalizer lead they will, of course, register only that current passing through it, which usually is but a small part of the load on the machine.

"Reader": What changes are necessary to make a 110 volt watt meter suitable for use on a 52 volt circuit, and vice versa, to make a 52 volt instrument register correctly on a 110 volt line?

Ans.—In the first case no changes are necessary, the instrument taking account of all changes in voltage and consequently slowing down to half the speed which it would run with the same current at 104 volts. Regarding the second point, a 52 volt instrument will register correctly on 110 volts, but as twice the normal current will pass though the potential coil it will very quickly burn out, so that it is necessary to insert in series with the potential circuit a resistance which should be of such a value as to increase the total resistance of this circuit to approximately twice its original amount, the constant on the dial being increased accordingly.

An eastern electric company write as follows: "What horse-power wheel is required to run a 5 k.w. exciter for a 200 k.w. S.K.C. generator? We wish to regulate our line voltage more owing to variations of speed of dynamo".

Ans.—The output of a wheel required to drive a 5 k. w. exciter at full load, allowing for the losses in the drive (belting, gearing, etc.,) and in the exciter itself, would be just about 10 h.p., and this would be about as small a wheel as would, in ordinary cases, be desirable to install, though as it is the general practice to make the exciter somewhat larger than the exciting capacity actually required, you will doubtless find it possible to drive the exciter at the actual output required to excite the generator by a somewhat smaller wheel. For the exact exciting current and voltage required you should consult the makers of the apparatus.

"G. R.", Montreal: I want to operate a number of bells from a single push button, all of them to ring at the same time. How should I connect them, in series or in multiple? What way should the batteries be connected?

Ans.—You will probably find it best to connect all the bells in parallel, though it will perhaps take a little more wire. If they are wired in series all but one will have to have the interrupter taken off, all the making and breaking of the circuit being done at this one bell. Should anything go wrong with it none of them will ring, whereas if they are in multiple trouble with any one will not affect the remainder. Your batteries will have to be connected to suit the number and size of bells you use; you may need two or three sets in parallel, each set consisting of two, or perhaps three cells, connected in series. A much preferable method, if you have the necessary dynamo current available, is to operate the bells by connecting them in shunt to part of a suitable resistance connected across the circuit supplied from the dynamo, and thus do away with the battery entirely.

"Student": Why are temperatures relating to electrical machines nearly always measured in the Centigrade scale, when the type of thermometer in general use is the Fahrenheit? What is the rule for changing a reading from Centigrade to Fahrenheit?

Ans.—The Centigrade scale, as its name implies, belongs to the decimal system, which is recognized by engineers and scientists as much to be preferred to the many other tables and scales which it is designed to replace, and as it can be used in electrical practice without its adoption causing the confusion and enormous expense such as would accompany the introduction of decimal coinage into England, or the metric system of weights into this country, it is used by electrical engineers as one step towards the introduction of a universal and world-wide system of weights and measurements. To convert a Centigrade reading into a Fahrenheit multiply it by 1.8 and add 32, though it should be noted that this is not the correct rule for converting a RISE of temperature, which if expressed in Centigrade terms, should be multiplied by 1.8 only, without adding 32, to express it as a rise in Fahrenheit degrees. Thus a temperature of 40° C = 104° F.; a rise of 40° C = a rise of 72° F.

"Ordinary Reason": Can any one give a valid reason why the underwriters call for No. 16 flex-cord on drop lights? It appears that when they are already limited to the use of only one light on a cord that No. 18 cord would be miles big enough. It makes conspicuous and cumbersome something that it is desirable to look otherwise. If No. 18 cord will carry 5 lamps of 16 c. p. without any perceptible heat, and it is protected with a suitable fuse in the rosette and fibre lined sockets, what more can be required. It will yet come to No. 0000 cable protected with iron conduits covered with rubber hose taped and painted for 8 c. p. lamps, and the dear knows what for 16?

Ans.—You must have been misinformed on this point, as the rules allow the use of No. 18 flex cord, but not smaller, but as this style of wiring, owing to the exposed position which it occupies, is peculiarly subject to strains and pulls, nothing smaller than No. 16 is really mechanically safe. In this connection must be taken into account the fact that any break will affect both conductors, and thus be much more likely to cause a short than in other styles of wiring, and on top of this is the fact that in the great majority of cases it is the midst of material which is highly inflammable.

ELECTRICAL PLANT FOR THE McCLARY MANUFACTURING COMPANY.

The McClary Manufacturing Company, of London, Ont., who are now building a large new foundry and erecting shop at the foot of William street, adjacent to the Thames river, in that city, have decided to adopt electric power for the operation of their entire works. For this purpose they are now building a power station 100 x 56 feet, with coal house extension 40 x 50 feet situated about 200 feet from the new building. The plans for the power station were prepared by Messrs. Moore & Henry, architects, of London, and provide for a brick and steel structure, with concrete floors and a large pit for the condensing apparatus and feed pumps and heaters. The plans and specifications of equipment were prepared and the plant installed under the supervision of Mr. Roderick J. Parke, consulting electrical engineer, of Toronto.

The boiler plant will consist of a battery of three 100 h.p. Scotch internal-fired boilers, with Morrison suspension furnaces and equipped with Jones improved underfeed stokers. A 6x6 Robb-Armstrong automatic engine, furnished by the Robb Engineering Company, of Amherst, N.S., will drive the forced draft fan for the stokers. Provision is made for the installation of a fourth boiler when required. In conjunction with the boiler plant there will be a duplex mechanical induced draft equipment, thus dispensing with the necessity and expense of a high chimney. There will also be installed a 400 h. p. Green fuel economizer, and feed water heaters and purifiers of the latest approved type. The working steam pressure will be 160 pounds per square inch.

Every facility will be provided for obtaining and handling the fuel supply at the minimum of cost. A railway siding will extend by a trestle through the coal house and the coal will be dumped from the cars into a receiving hopper, thence distributed to the coal storage bins and when required will be carried by conveyors to the bunkers is the boiler room. The bunkers will have a total capacity of 60 tons, while the coal house will be capable of storing 600 tons. The coal handling machinery will be driven entirely by electric power.

The engine equipment will include a 12 and 20 x 14 inch tandem compound Peerless engine from the works of E. Leonard & Sons, London. This engine will be direct-connected to a 125 k. w. 250 volt direct-current generator of Westinghouse make. The unit will furnish power for the new factory and will be supplemented eventually by a similar 125 k.w. dynamo and engine to furnish power for driving the present factory, about one mile distant.

There will be installed at once a second unit consisting of a 10 x 10 inch Peerless engine and a 50 k.w. 250 volt direct-current Westinghouse generator. This will be used to furnish additional power for lighting when required and for the cupola blower service. This unit will be operated in parallel with the 125 k. w. unit for from two to four hours per day in taking care of extra load.

The distribution in the present and new factories will be by 250 volt two-wire system, with three-wire 500 volt transmission from the power station to the present factory up-town. It is expected that the power station will be in operation by April 1st, 1903. The instructions of the company to their engineer call for the design of a plant of the highest possible commercial efficiency commensurate with a reasonable expenditure, and it is expected that when completed this plant will rank as one of the most complete and up-to-date power station for a manufacturing establishment yet built in Canada.

ELECTRIC LIGHT INSPECTION.

The annual report of the Inland Revenue Department of Canada furnishes particulars regarding the inspection of electric light during the year ending June 30th, 1902. The fees for the inspection of meters were $16,373.75, and for registration of companies $5,055, making a total of $21,428.75. The expenses of inspection were $5,172.94, and there was expended on standard instruments the sum of $4,088.74, leaving a net revenue of $12,167.07. On July 1, 1902, the annual registration fees for electric lighting companies were reduced to $5 for companies having installation of 500 lamps and under, $10 for over 500 lamps and not exceeding 2,000 lamps, and $25 in excess of 2,000 lamps.

Of 12,276 electric light meters presented for inspection, 12,022 were accepted as coming within the error tolerated by law, 152 were rejected, and 102 were verified after first rejection. The following table furnishes the details:

Divisions.	Number Presented.	Vertified as within the error tolerated by law.			Rejected.			Vertified after First Rejection.		
		Correct.	Fast	Slow.	Unsound.	Fast.	Slow.	Correct.	Fast.	Slow.
Belleville	463	270	84	100	....	....	....	....	....	....
Hamilton	658	320	231	106	....	....	....	....	1	....
London	640	216	202	218	....	2	2	....	....	....
Ottawa	2,036	384	520	1,090	7	8	3	9	1	5
Toronto	1,609	174	714	642	....	57	22	....	....	....
Montreal	2,895	1,581	827	417	4	21	3	23	14	5
Quebec	1,029	400	374	252	....	1	....	....	1	1
Sherbrooke	27	5	2	18	....	....	2	....	....	....
St Hyacinthe	88	88	....	....	....	....	....	....	....	....
St John	491	105	111	275	....	....	....	....	....	....
Halifax	656	434	119	66	1	14	3	14	2	3
Charlottetown	12	1	4	5	....	....	2	....	....	....
Winnipeg	373	101	61	211	....	....	....	....	....	....
Vancouver	797	187	196	391	....	....	....	5	6	12
Victoria	502	166	116	220	....	....	....	....	....	....
Totals	12,276	4,432	3,570	4,020	12	103	37	51	25	26

The report shows that there are now registered in Canada 315 electric lighting companies, of which 200 are in Ontario, 49 in Quebec, 11 in New Brunswick, 24 in Nova Scotia, 3 in Prince Edward Island, 12 in Manitoba and the Territories, and 16 in British Columbia. The report of 1899 showed a registration of 276 companies, so that within three years 39 new companies have commenced business. Then existing companies, however, have obviously greatly extended their business, as the number of arc lamps operated increased during the three years from 10,960 to 12,884, and the number of incandescent lamps from 546,672 to 984,956. Estimating that one arc lamp is equal to ten incandescents, there were in use in 1899 the equivalent to 656,200 incandescents, and in 1902 the equivalent to 1,113,796 incandescents, an increase during three years of over 75 per cent.

The comparison may be carried further as showing the greater efficiency of the meters on the market to-day as compared with those manufactured three years ago. In 1899 196 meters were rejected out of a total of 5,762, whereas this year only 256 were rejected out of a total of 12,276 meters.

THE MONTREAL STREET RAILWAY COMPANY.

The forty-second annual meeting of the Montreal Street Railway Company was held in Montreal on Nov. 5th, Hon. J. L. Forget presiding. The report of the president and directors showed net earnings for the year of $911,032.27, as compared with $795,413.20 last year. Four quarterly dividends were declared, and after paying interest on bonds and loans and the city percentage, and transferring $100,000 to the fire insurance fund, there was a surplus of $965. The directors called attention to the fact that the operating expenses per cent. of gross earnings showed a substantial decrease. Several new extensions to the company's system, amounting to fourteen miles of track, were constructed and put in operation during the year and the rolling stock was increased by the addition of 29 motor cars.

The receipts in 1902 were $2,046,208, which is 7.66 per cent. more than in 1901; the operating expenses $1,135,176, an increase of 2.70 per cent. The net earnings were $911,032, or 14.54 more than in 1901. The net income per cent. of capital was 11.68. The passengers carried in 1902 were 49,947,467, being 3,205,807 more than last year.

The following table shows the number of passengers carried during the past eleven years and the operating expenses per cent of car earnings:

	Passengers Carried.	Operating expenses per cent. of car earnings.
1892	11,631,386	82.68
1893	17,177,952	79.00
1894	20,569,013	71.16
1895	25,877,758	59.20
1896	29,896,471	56.48
1897	35,047,317	55.05
1898	35,353,036	52.15
1899	40,186,493	55.23
1900	43,362,262	56.34
1901	46,741,660	58.82
1902	49,947,647	56.39

Mr. F. L. Wanklyn, general manager, gave a brief account of the precautions which were being taken against fire. Sprinklers and all modern appliances had been placed throughout the company's buildings, and it had been found from experience that it was cheaper to do their own insurance and to set aside a sufficient reserve fund for that purpose.

The old board of directors were unanimously re-elected, and at a subsequent meeting of the directors the following officers were chosen: President, Hon. J. L. Forget; vice-president, Jas. Ross; secretary-treasurer, W. G. Ross; general manager, F. L. Wanklyn.

The city engineer of Winnipeg, Man., has been instructed to report as to the cost of constructing an electric railway from Winnipeg to the Stoney Mountain quarry. It is proposed to operate it under municpal control.

The Snowshoe Gold and Copper Mine, Limited, of Phoenix, B. C., are installing a 150 horse power hoist, which will be operated by electric power furnished by the Cascade Water, Power & Light Company. The plant of the latter company is now nearing completion.

The Sherbrooke Light & Power Company have completed a new dam at their power station on the Magog river. The dam is 150 feet long, with gate house and bulk head at the south end, where there are two steel tubes eight feet in diameter. One of these is reserved for future extension. There are fifteen gates on the dam, each 7 feet wide and 6 feet deep. The power provided by the dam is estimated from 1,500 to 2,000 horse power. The plans and specifications for the work were prepared by Mr. A. Sangster, superintendent for the company.

LARGE POWER DISTRIBUTION SCHEME IN SCOTLAND.

A bill has recently been sanctioned by Parliament which gives authority for an extensive power distribution scheme contemplating the supplying of power to the industrial region of the lower Clyde River in Scotland. The district covered by the bill includes that part of the Clyde Valley extending about ten miles on each side of the river and about twenty miles up and down stream from Glasgow. The area covered is about 700 square miles, and three generating stations will be erected to meet the demand for power. The scheme has been promoted by a group of manufacturers who desire to obtain cheap electrical power and who realize that this can be better done by joining in a common system than by each putting down his own generating plant.

This is the busiest part of industrial Scotland and contains about 1200 works, many of which are large iron and steel works, coal mines, shipbuilding yards, and chemical works. Some of these works will alone require more power than many of the local municipalities now provide for lighting purposes, and it was easily shown that it would be inadvisable for the separate boroughs to attempt to supply an amount of power involving so large an expenditure of capital.

The three generating stations are to be built at Motherwell, Yoker, and Crookston. The Motherwell station is located in the neighborhood of a large number of manufacturing works and in the centre of an extensive coal field and can be connected with the adjoining line of the Caledonia Railway. It is, also, in close proximity to the river Clyde, from which water for steam and condensing purposes can be obtained.

The Yoker station is also situated on the Clyde, near the line of the Lanarkshire and Dumbartonshire Railway, and is in close proximity to a large number of shipbuilding yards, works, and docks. Authority has been obtained to lay cables across the Clyde from Yoker to Renfrew, which will enable the works at Renfrew, and other works on the south side of the river, to be supplied from this station.

The third generating station will be situated near Crookston, on the Glasgow & Southwestern Railway, Canal line; but, owing to the arrangement allowing the company to cross the river, it will not be necessary to construct this station immediately.

The works from which the most urgent demands for power have been received are situated in the areas immediately surrounding the first two sites, and it is intended, therefore, to proceed with these stations first and to install in each a plant of about 4500 k. w. capacity. They will be so designed that they can be enlarged from time to time, as the demand requires. A radius of 14 miles from these stations covers practically the whole district in which the company will be allowed to distribute their power, but a large proportion of the works are located within a radius of six or seven miles of the stations. When the stations are in operation, they will probably be coupled together electrically, enabling them to share the loads and average up their power factors or to supplement or aid each other in any emergency. The capacities of the respective stations will ultimately be about 10,000 k.w. each at Motherwell and Yoker, and 5,000 k.w. at Crookston. By utilizing cheap sites for the stations outside of towns and near to the coal mines, it will be possible to generate power at a very low cost. Of the 710 square miles covered by the scheme, only 13 are at present supplied with electricity. It is said that over 300 manufacturers petitioned in favor of the proposition, and it is thought that many of the remaider petitioned in favor of the rival Caledonian scheme which was turned down. The carrying out of this mammoth scheme of power distribution will place the manufacturers of Glasgow on a footing to be compared to that of American manufacturers who are so fortunate as to be within range of our cheap water powers.

The authorized capital of the Clyde Valley Electrical Power Company is $4,500,000, with borrowing powers of $1,500,000. The total cost for plant on the transmission lines is estimated at over $2,000,000. The electrical apparatus, which will comprise polyphase alternating-current generators and transformers for high voltage power distribution, rotary converters for the supplying of direct current, etc., has been contracted for with the British Westinghouse Electric & Mfg. Company. Messrs. Strain & Robertson are the engineers of the Clyde Valley Electrical Power Company. Mr. Robert Robertson has recently spent a considerable period on the American continent investigating systems and methods of power transmission and distribution.

TYPE "R" PACKARD TRANSFORMER.

The Packard Electric Company, of St. Catharines, Ont., are placing on the market a transformer which they claim to be superior in every way to any transformer yet made. It is designated Type "R," and embodies a style of construction which not only makes the transformer much more compact than the old styles, but of much lighter weight. The space for ventilation has been increased by a new adaptation of the coils, which have nearly three-quarters of their entire surface exposed and outside the core. The coils are so imbedded in insulated tape and other insulating material that ventilation seems almost impossible. The coils are assembled in two sets, each set enclosing one side of a single magnetic circuit, the core being placed partly within the coils. There is the same radiation in the secondary as in the primary. Mica is used throughout for the insulation, a feature peculiar to this new type.

The type "R" transformer is designed for oil or air cooling. It is regularly made for primary voltages of 1,000 and 2,000 and the secondaries are arranged for operating on 50, 100 and 200 volts in the small sizes, and 100, 200 and 400 volts in the large sizes, so that with a primary voltage of 2,200 all transformers over 150 lights capacity can be used for 440 volt motor installations.

STEAM-TURBINES.*

By S. E. Fedden, City Electrical Engineer, Sheffield, Eng.

The technical details of the steam-turbine have been very prominently placed before engineers lately in numerous able papers, and the author does not consider it necessary to go over this ground again. Suffice it is to say that the construction of the steam-turbine is simplicity itself, as it consists only of a hollow drum revolving in a stationary drum or cylinder, each with teeth or vanes attached, and so arranged that they clear each other. The two cylinders are steam packed, and, of course, the thrust guides require careful adjustment so that the vanes do not clash. Of late years this turbine engine has been meeting with signal success, and many engineers are now considering whether it is not destined to revolutionize the means of obtaining power from steam both by land and by sea. The author suggests, however, that engineers and inventors should turn their attention towards bringing to perfection gas-turbines, now that cheap gas is available, and the ideal engine, combined with the most economical way of obtaining electrical energy from coal, may then result.

The fundamental principle attending all methods of electrical working is implied by the word "velocity," a requirement eminently possessed by the dynamo, motor, and rotary converter, owing to the entire absence from these machines of reciprocating parts. This requirement, however, is not possessed by the prime mover—the modern reciprocating engine. Velocity was first obtained on the dynamo by means of belts or ropes, but this method of driving was soon discarded; it took up too much available floor space, and was an unsatisfactory and inefficient arrangement at the best. The attention, therefore, of the most prominent engineers in the world was directed towards increasing the speed of the engine, so as to adapt it for direct coupling to the high-speed dynamo or alternator. The efforts of these engineers were attended with very great success in Britain, and they were able, not only to couple their new high-speed engines to the dynamos, but they also obtained those qualities of economy and reliability of working claimed for the slow-speed engine with its belt drive, and the market now supplies high-speed engines of moderate sizes and of British manufacture which are second to none in the world.

The demand for electrical energy for all purposes has, however, increased by leaps and bounds, and has thus called for larger generators and larger engines with heavy reciprocating parts; therefore more strain and wear, bringing increased engine troubles. High-speed engines are now being built with pistons considerably over two tons weight. Such a piston will have to start and stop from 400 to 500 times per minute. When this enormous weight, making so many reversals per minute, is considered, it will not be difficult to imagine the steam-hammer effect obtained if the least thing goes wrong with the valve setting or the compression. On account of the increased engine troubles with high-speed engines, manufacturers are now falling back to moderate speeds, and many to slow speeds, although this is attended with an increased cost of the plant. Taking into consideration the large demands for electrical energy which must be made in the near future, it seems probable that the size of the generator and slow-speed engine will become unmanageable, also great difficulties will be experienced in shipping and erecting the same. The aim of all engineers should be simplicity, and the modern reciprocating engine, with its numerous complications, cannot by any means be considered the embodiment of this principle of simplicity. The great number of its moving parts, which require watching and adjustment, increases the cost of maintenance and attendance. Engineers who have had charge of power stations of from 6,000 h. p. to 10,000 h. p. are fully aware of the laborious and never-ending work and watchfulness required to maintain their reciprocating engines in fair running order; the station calls incident to the taking up of brasses, repairs and adjustments to valves, gland packing, cylinder lubrication, automatic governors, trip valve gears, and many other things, are items that go to build up the daily and nightly experience of the present-day station engineer. Engineers laying down new plant have to consider the increased cost of building, the larger floor space required, the longer lengths of steam and exhaust piping, valve-opening gears, and heavy cranes for lifting which are required in the case of large reciprocating engines, as against the requirements of a station laid out with steam-turbines. The massive nature of foundations, the time required for delivery and erection of large plants, are items which often seriously delay the speedy completion of contracts.

It was owing to these and similar reasons that the author's attention became directed towards the steam-turbine offering a possible solution of the difficulty, and a short experience with generators of this type has since formulated his belief that progress in the generation of electrial energy lies in this direction. The failure of the steam-turbine to secure earlier appreciation was probably due in great measure to that inherent conservatism to which British engineers are only too liable. Two years ago the author had the opportunity of going through the country to inspect all the larger turbine installations, and the conclusions then arrived at were: (1) it was inadvisable to put down a steam-turbine to exhaust to atmosphere; (2) it was inadvisable to put down a steam-turbine of a small size; (3) it would be policy to instal steam-turbines from 200 k.w. to 300 k.w. and upwards either for alternating or continuous current generation for lighting or power, provided there was a plentiful supply of cold water available for condensing purposes, and also provided that surface condensers were used, all the water being returned to the boilers.

From the year 1885 until 1890 nearly all the turbines manufactured were non-condensing of comparatively small type; they were not economical—in fact, many engineers called them steam-eaters, but great improvement, both in construction and design, has since been made in them, and this has led to a very much smaller steam consumption, so that there is now on the market a steam-turbine which, in the larger sizes, and in the matter of steam consumption, is capable of holding its own against any triple-expansion engine yet produced. Even in the early days, when they were considered steam-eaters, their smooth running and general adaptability to the driving of electrical machinery was the subject of much comment. The author, however, wishes to call the attention of the members to a few of the advantages which the adoption of the steam-turbine, when running under ordinary conditions for working in a power station, has impressed upon his mind. As many members are no doubt aware, a steam-turbine of 500 k.w. capacity, 100 cycles single-phase, was brought from the Paris Exhibition into the Sheffield station about 18 months ago, and was running on the town load within three days of the time of its arrival at the station doors, and within about three weeks of the date of the order by telegram. It was simply dropped down on the station floor, without any preparation in the way of foundations, and has since, over the period stated above, run more or less continuously and during longer hours than any other plant in the station. It runs in parallel with alternators both of the iron and copper type, with engines of the triple and compound type, and can be brought up to speed to meet the demand of a sudden load much more quickly than any other of the neighbouring plants. Boiler priming or wet steam simply causes momentary slackening of speed until the turbine clears itself of water. Other advantages are as follows: (1) Absolutely steady nature of turning moment. (2) Entire absence of cylinder lubrication, which, therefore, allows of all the condensed steam being returned to the boilers. The saving in this one item alone materially assists in the reduction of station costs. (3) The time occupied in cleaning down is brought to a minimum, and is about one-sixth of that required with a reciprocating engine of similar capacity. (4) The entire absence of rubbing surfaces and packed glands within the steam-chamber will permit of the use of superheated steam without fear or injury. The turbine specially lends itself to the use of superheat of a high temperature, and in this respect possesses a considerable advantage over a reciprocating engine. (5) Exceedingly small costs for attention and repairs, and great reliability of working. These last items bring home to the engineer more forcibly than anything else the advantages of a purely rotary as opposed to a reciprocating motion. When considering the laying down of a steam-turbine plant, the main factors to be considered are:

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*Paper read before the Municipal Electrical Association.

First.—Good vacuum in the condenser. This is even more necessary than with an ordinary engine, as the makers claim that the turbo expands the steam right down to the vacuum of the condenser. The following table of actual tests taken on a 500 kw. set illustrates how important it is to obtain a high vacuum:

Consumption of 500 k.w. Turbo-Alternators, Running at 2,500 Revolutions with 140 Lbs. Steam Pressure at the Stop Valve and no Superheat.

Vacuum constant from full load to no load. Inches of mercury.	Consumption per kilowatt-hour			
	Full load	Half load	Quarter load	No load
29	—	—	—	1,500
28	22.2	25.6	32.4	1,700
27	23.1	26.9	34.5	1,900
26	24.0	28.2	36.6	2,100
25	25.1	29.7	39.0	2,300
24	26.2	31.2	41.2	2,500
23	27.5	32.9	44.8	2,700
22	28.9	34.7	46.3	2,900

Second.—Arrangements for high superheat, as tests show that with 50 deg. F. of superheat, there is 8 per cent., and with 100 deg. F., 12 per cent. economy in steam consumption. From the tests taken on the 1,250 k.w. steam-turbine sets, which are now working satisfactorily at Elberfeld, in parallel with Sultzer engines, where the speed ratio is something like 16 to 1, it was shown that there was a gain of 12 per cent. with 55 deg. C. superheat, and that every inch of vacuum improves the steam consumption by 4 per cent. It was also shown that the steam consumption in the turbines, other things being equal, decreased constantly with increasing loads, whereas the Sultzer engines showed a less economy over three-quarter load.

The steam consumption in a turbine closely follows the right line law, or is proportional to the load added to a constant quantity which represents the consumption of steam at no load. The new 1,500 k.w. turbo-alternators which the author is installing at Sheffield power station will, with their own condensers, only occupy the space of 730 feet. The foundations will be of the simplest description, and the general compactness of the sets and the ease of erection are expected to effect a considerable saving of time and money. The appearance of the station will be improved by the absence of ugly lengths of steam-piping, or cylinders poised up in mid-air to obstruct the lighting of the building, and altogether the author hopes that there will be a general absence of that complexity of moving parts which to the trained eye of a station engineer offers so many possibilities of failure. The author has been severely criticized for starting a large power-house with steam-turbines, but time may show whether this criticism is deserved. At present, however, he feels quite confident, after considering the problem from all points, that the steam-turbine stands in a most favourable position when compared with reciprocating engines of large powers for the supply of electrical energy.

The exchange of the Bell Telephone Company at Ingersoll, Ont., is being enlarged and remodelled.

"Work Done" is the title of a book just received from the Westinghouse Companies Publishing Department. It contains a record of some of the work done in the field of high-speed interurban railway engineering by the firm of Westinghouse, Church Kerr & Company. The book is illustrated by half tones from photographs and by reproductions from working drawings.

THE DISTRIBUTION OF ARTIFICIAL LIGHT.

The Westinghouse Electric & Manufacturing Company, representing the Nernst Lamp Company, have issued a little booklet dealing with the distribution of light and setting forth the advantages of the Nernst lamp in this respect. The following extracts are taken therefrom :

The engineers who developed the Nernst Lamp kept in mind from the outset the importance of a correct distribution of light, and before determining the general form of the new lamp studied carefully the desirable and objectionable features of other illuminants. It was found that the horizontal rays from the arc lamp, for instance, were generally unsuitable, and after careful consideration, it was decided to make a more downward distribution of light from the Nernst Lamp. In this connection it is interesting to note what is found in Nature. The sun at rising and setting projects its rays horizontally into our eyes, but at such times the light is much softened and the intensity greatly reduced. During the working hours of the day, however, the sun reaches a position in which the light can be greatly intensified without injury or discomfort to one's eyes. Our eyes are well protected from these vertical rays, but are unsuited for light projected in a horizontal direction, and it is obvious that we are unaccustomed to a horizontal distribution of intense light in Nature; at the same time it is uncomfortably evident that horizontal distribution is found in the methods of street lighting now in vogue. This refers more particularly to the arc lamp, which throws an abundance of light horizontally along the street, much after the manner of a search-light or locomotive head-light, with the result that horizontal rays of great intensity are projected into the eyes of pedestrians, teamsters and horses.

In the Nernst Lamp it has been sought to avoid the error above described by more closely imitating Nature, and in a number of places where the Nernst Lamp has already been introduced for street illumination the results have been found wonderfully pleasing. The lamps have been placed at about the same elevation as the ordinary arc lights and at varying intervals, according to the size of the unit selected. The result is that instead of the unsteady horizontal beams and the dense shadows underneath the arc lamp, we have a soft white light evenly distributed over the street, to the great relief of the eye.

It is interesting to note the pleasing effects which are now being produced with the Nernst Lamp by using in large interiors only one quality of light, in distinction to the always unpleasant and inartistic combination of the bluish-white arc and the yellow incandescent. In this respect, the Nernst Lamp offers for the first time a uniform quality of light in all sizes of units, and is the only electric light capable of being made in a practical and efficient form for both high and low candle powers.

The first requisite of artificial lighting is a fair general illumination from above; then, if a reading or writing light is desired, it should be located well above the eyes and back of the reader so that the light will be cast over the left shoulder. As a writing light, the lamp may be placed well above the line of vision, preferably six feet from the floor and about a foot to the left of the writer's head, so that no shadow will be cast by the writing hand. The light should be thrown downward, giving a good general illumination over the entire desk or table.

To obtain the results above described has been the object of the makers of the Nernst Lamp, and it is very gratifying to note that users of light are already learning to appreciate the benefits to be derived from a lamp which has been so carefully designed with reference to a proper distribution of light.

Mr. Hartley Gisborne, a member of the Institute of Electrical Engineers, London, England, has received the appointment of electrical engineer for the Tyee Company, which is installing an electric system at the Tyee smelter in British Columbia.

A number of insurance underwriters recently made an inspection of the Hill automatic electric switch at the factory of the company, 426 St. Paul street, Montreal. The invention is intended to prevent electric fires due to high voltage and to grounding, and was endorsed by the underwriters as a step in the right direction.

Hon. Mr. Prefontaine has made the statement that there is no reason why the St. Lawrence channel should not be so lighted at night as to make it as navigable during the hours of darkness as it now is in the day time. He believes that an appropriation for the purpose will be granted by the Government and that the work of perfecting the lighting will be completed by the fall of next year.

LAKEFIELD AGAIN LIGHTED.

After an uncomfortable transition from electricity to coal oil for some weeks past, reminding the citizens in some degree of the Egyptian darkness of old, live Lakefield is once more rejoicing in the blessings of electric light. The current from the new company's power station was turned on for the first time on Tuesday evening at five o'clock. Business men, especially, are particularly happy, and are congratulating the new company on their enterprise. The success of the new light is already assured, and the encouragement shown by the number of users is taken as evidence of the appreciation of the long-felt want and the desire to encourage the promoters. The Farrer Bros., who have installed the plant, have done their work in a practical and up-to-date manner. The outfit is wholly new, and produces a brilliant, clear, white light. The rates, also, are said to be very moderate.—Peterboro Examiner.

Concerning the above a correspondent sends us the following communication :

The Farrer Brothers referred to last spring purchased from Madill Bros., of Lakefield, their old series arc and incandescent system. They have installed a complete new alternating current system in its place, comprising a 40 k. w. Royal electric alternator and exciter with switchboard, purchased from the Canadian General Electric Company. They have also adopted the very latest ideas in street lighting, using the C. G. E. enclosed a. c. arc lamps, eight in number at present,which are giving excellent satisfaction. The members of the new firm understand their business thoroughly and are to be congratulated upon their enterprise and perseverence, especially in the face of so much opposition in the first place.

Mr. Chas. L. Farrer, the elder member of the firm, and under whose supervision the new plant was installed, is well and favorably known to the electrical fraternity in Ontario and Quebec, but especially in the latter, having held responsible positions in nearly every department of the Lachine Rapids, Hydraulic and Land Company, Montreal. Mr. Farrer was with this company almost from its inception and grew up with it, so to speak, from its infancy to almost its present proportions, developing 12,000 h. p. He left to take charge of the high potential (10,000 volts) plant at Chaudiere Falls, Que. Just before severing his connection with this company to accept a tempting offer from the Montgomery Water Power Company, Alabama, Mr. Farrer took unto himself a life partner in the person of Miss Ethel Pruner, one of Morrisburg's fairest daughters, upon which occasion he was presented with a beautiful gold locket suitably engraved. Mr. and Mrs. Farrer shortly after left for their new home in Alabama, where Mr. Farrer was engaged to take charge of a 5,000 h. p. power house transmitting current to the city of Montgomery, 30 miles distant, at 30,000 volts. The huge stone dam of this company being washed away by flood last December, with no prospect of it being rebuilt in the near future, caused Mr. Farrer to return to Canada, deciding to locate at Lakefield. Lakefield people should congratulate themselves not only on the excellent light and service which we noticed on one of our recent trips to that progressive town, but also on having added to their population one so worthy of their esteem and confidence. Mr. L. L. Farrer, the younger member of the firm, while not having the experience of his older brother, is nevertheless clever at his business and was for a few years with Mr. Jas. Easton, inventor of the Easton Patents afterwards controlled by the Reliance Company. The Messrs. Farrer Bros. are sons of Police Magistrate Farrer, of Parry Sound.

BOILER EXPLOSIONS.

An instructor in science at the College of the Sorbonne, in Paris, has made a study of boiler explosions, a large portion of which he thinks to be due to the inefficiency of the safety-valves in common use. As he observes, a safety-valve which is held to its seat by a spiral spring, as is the case with those on small and cheap boilers, never shows at the valve, when open, a pressure so great, by many pounds to the square inch, as that which actually exists inside the boiler, for the reason that as soon as the valve opens in the slightest degree, the escape of a portion of the steam just under the value reduces the pressure of the remainder. Supposing the safety-valve be set to open, for example, at one hundred ponnds to the square inch, while it will begin to leak steam at that pressure, it cannot be held open until the boiler pressure is far beyond that, as the pressure required to hold it open must be one hundred pounds to the square inch plus whatever is lost under the valve by the escape of a portion of the steam. Moreover, as with a cheap valve, the force of a spiral spring increases greatly as it is compressed by opening the valve widely, while the wider opening of the valve reduces still more the local tension of the steam, it follows that to hold the valve up, so as to keep an annular opening around it equal in width to one-fourth the diameter of the valve, which is necessary to give free escape to the steam; requires a pressure inside the boiler far greater than that at which the safety-valve is set, the difference varying with the spring, the pressure and the size of the valve. In this country, the simple spring safety-valve is only used on the cheapest boilers, our engineers having long understood its defects, but M. Fournier's interesting paper will be useful, even here, as showing clearly the nature of the danger attendant upon its employment.

OUT FOR THE WORLD'S TRADE.

The Electric Repair & Construction Company, of Cleveland, Ohio, whose advertisement appears in this issue, is one of the new electrical concerns of Cleveland. At their works on Sheriff street they show a large line of dynamos and motors, also electrical and water fans, all of their own manufacture. They can supply electric machinery from ¼ h.p. to 10 h.p., also anything required in the electrical supply line. Their one h.p. machine is a marvel of neatness and strength. It has distinctive features in having no perceptible variation in speed from "no load" to "full load." This was demonstrated in actual trial by a representative of this paper. The speed on this machine is 1300 revolutions per minute, which is a very desirable speed. This high efficiency is the result achieved by the use of the very best materials obtainable and skilled electrical experts. The brush holders are direct acting. This company have recently organized, and are now fully equipped to attend to their ever increasing volume of business. They are turning out the various types of dynamos and motors in lots of a dozen at a time. It takes expert mechanics to do repair work, and they make a specialty of this branch of their business. Mr. E. Snyder, well known as an expert electrician, is the general manager of this company.

A GREAT VALVE INDUSTY.

At Sandusky, Ohio, is one of the largest valve manufactories in the world. It is that of the Vincent Valve Company, manufacuturers of gate and globe valves, as well as all water-works specialties and a line of brass novelties. The immense plant of this company, while a comparatively new one, has recently been again increased by the addition of a large brass foundry. The people of Sandusky, through their wide-awake Chamber of Commerce, have shown their appreciation of such a great establishment in their midst and have given gratis to the company a valuable plot of land needed to increase the already large capacity of the works.

The Vincent Valve Company are now establishing representatives in all parts of the world to handle their goods. They are for the first time going into the export trade. With their new equipment, and employing three times the number of men employed last year, they are fully prepared to invade the foreign market.

While at the works our representative was very kindly shown through the vast establishment by Mr. E. C. Bacon, the very energetic secretary and manager. There were found to be orders on hand from the United States Government, a hundred expert mechanics being employed on this work alone. The Navy Department are great believers in the Vincent valves, solely on account of their peculiar construction. As a consequence they place their orders for valves required for their cruisers and battleships with this company.

The moulding and casting department shows a very busy scene—one casting our representative saw was three tons in weight. The workmen are divided into night and day shifts and the company are now advertising for additional expert brass and iron moulders.

Among their products is the Standard Globe, Angle and Radiator valves, as well as the heavy pressure line, which they fit with regrinding discs and seats. The Vincent adjustable wedge gate valves have become a fixture in the market, and their success is owing to the simplicity of their construction, small number of parts, superior workmanship and special metal mixture.

The Vincent Hub or Ball End straightway valve is one of the strongest valves of the gate pattern made. It is simple and durable because the friction is reduced to a minimum by its peculiar construction. They claim that it has a less number of joints of bearing than any other valve made. In the Vincent the stem nut has no duty to perform but to raise or lower the gates, the operation of seating the gates being performed by the adjustable wedge alone. By the use of the adjustable wedge all danger of stripping the threads is avoided.

The Vincent composition disc globe and angle valves are designed for working pressure up to 160 lbs., and are regularly fitted with composition discs, made expressly for the Vincent Company from the best formulas known. The metal is their own special mixture and the workmanship and finish are not excelled. They also fit these valves with a reversible metal disc. Each valve is carefully tested before leaving the works and they guarantee them to be superior to any on the market.

Their heavy pressure valves are fitted with an outside screw case and inside screw bonnet, which has a double seat at the top edge of the case and at closing joint at outside. It is an impossibility to strip the thread without it being discovered. Expansion of metal under great temperatures tightens the joints instead of causing them to become loose, as in the old fashioned valve, a difficulty overcome which will be appreciated by all users.

SPARKS.

A by-law was carried recently by the ratepayers of Goderich, Ont., authorizing the council to take $50,000 of stock in the Huron, Bruce and Grey Electric Railway Company.

The Modern Telephone Company, of Hamilton, Limited, have issued their stock book. The capital is placed at $300,000, $70,000 of which has been subscribed by Messrs. O. W. Rogers, J. T. King, W. A. Johnson and H. A. Drummond, of Toronto, and J. A. Scovell, of Lewiston, N.Y.

The Bell Telephone Company have made a new agreement for a telephone system in Hull, Que. For business telephones the charge will be $45 and for private telephones $30. The city will have four telephones at $25 each. Six public telephone stations will be established at places to be named by the council.

At Sault Ste. Marie, Ont., there are 406 telephones installed. When Mr. Burrows, the present manager, assumed his duties there about two years ago, the exchange comprised only 125 instruments. It is understood to be the intention of the Bell Company to remodel the exchange and to install the improved type of battery.

A syndicate of Toronto capitalists, including Mr. Wm. Mackenzie, president of the Toronto Railway Company, and Mr. Frederic Nichols, managing director of the Canadian General Electric Company, have approached the commissioners of the Queen Victoria Park with a view to securing privileges for the development of electric power at Niagara Falls. The new company desires to establish its works between the plants of the Ontario Power Company and the Canadian Niagara Power Company. One of the chief objects aimed at is to secure a portion of the power developed at the Falls for Toronto and other Canadian cities.

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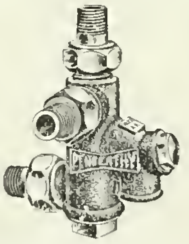

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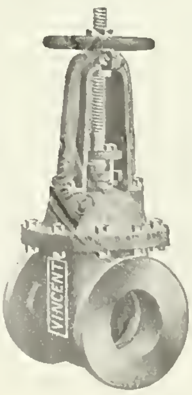

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